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Minnesota Phalaenidae (Noctuidae)

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Herbert Knutson

INTRODUCTION

THE large and destructive Phalaenid family, consisting of armyworms, cutworms, borers, and related types, has never been the object of much study in the North Central States. Furthermore, most of the existing literature consists of fragmentary notes. Control measures against any single Phalaenid species are necessarily based upon a knowledge of its seasonal history in a particular latitude and longitude, and upon records of its past economic importance. This work consists of such a study of 395 species, and additional forms, which occur in Minnesota.

Economic Importance

Phalaenids are among the most destructive insects in the state, and during numerous years have ranked first as field and garden pests. Since the outbreak of war, the Minnesota agricultural program has called for the greatest increase in production from the small victory garden to the enormous fields of the Red River Valley. No attempt to evaluate destruction by this family in Minnesota has ever been made, but the variegated cutworm alone destroyed $2,500,000 in crops in a single year in the United States and Canada (Chittenden, *1*), and it is estimated that American farmers annually grow an average of two million acres of corn which is lost to one single species, the corn earworm (Metcalf and Flint, *21*). Spring cutworm damage to gardens is so common that gardeners are inclined to accept it as inevitable, and reports of damage to both field and garden crops are usually restricted to large outbreaks.

Old Minnesota newspapers tell of destruction to crops of the early settlers. Since the appointment of the first Experiment Station Entomologist, Otto Lugger, in 1888, reports of damage have

been prevalent every year. The armyworm has been by far the most destructive, with many thousands of acres of damage to its credit. Second in rank has been the variegated cutworm, which is not as totally destructive as the armyworm. Several other species, usually with either cutworm or armyworm habits, are locally destructive every year. Still others, such as the corn earworm and the stalk borer, are somewhat destructive almost every year, but seldom reach outbreak proportions.

Lugger recorded destruction each year throughout his entire service in office (1888-1901), but the only unusual outbreak was that of the armyworm in 1896.

Washburn *(29)* reported damage by the family in certain localities, especially in the flax-growing regions, and *(32)* found the armyworm quite abundant. He recorded little damage in 1908 *(33)* except to flowers and ash by *Papaipema.* Washburn *(37)* stated that damage by the family was "bad in 1909, much worse in 1910, and climax in 1911," with the wheat-head armyworm and the armyworm playing the leading roles in 1910; in 1911 several species of cutworms were extremely destructive all over the state, but he received few complaints in 1912.

Relatively little mention was made of serious destruction again until Ruggles *(24)* ranked cutworms as the most important garden pest in 1918. A serious outbreak of the armyworm and variegated cutworm occurred in 1919 (Ruggles, *25*), followed by another outbreak of the former in 1920 in another locality.

An examination of the files of the State Entomologist for inquiries of control measures, county agent reports, and insect pest survey reports, shows that no serious outbreaks took place for the next 16 years. Numerous minor outbreaks occurred, however, with the usual number of complaints of cutworms in the spring. A state-wide minor outbreak of the corn earworm occurred in 1921 (Ruggles, *26*), and considerable damage to flax took place in 1926. Mickel *(22)* reported damage in 1932 by the armyworm and spotted cutworm in southern Minnesota. In 1935 considerable damage was done to a wide variety of crops by *Feltia ducens* Wlk., *Agrotis gladiaria* Morr., the variegated cutworm, and several species of *Euxoa.* The distribution of cutworms in 1930 was general, with reports most prevalent in June and early July. In 1931, damage by cutworms was reported at about the same time, but smaller areas of heavier infestations occurred in a belt extending southeastward from the northwest and north-central areas to the east-central portion of the state, a southwestern area with lighter infestations eastward and extending northeast to

the Twin Cities, and a small area in Wilkin, Traverse, and Stevens counties. The 1932 cutworm infestation was heavy in the east-central area, in a southern triangle-shaped area bordered by Jackson, Nicollet, Le Sueur, Ramsey, Rice, Steele, and Mower counties, and in a small southwestern area.

In 1937 the variegated cutworm and the armyworm did enormous damage; the latter occurred in the southern portion and the western tier of counties as far north as Crookston. A 1938 outbreak of the armyworm occurred in the Red River Valley. There was a small outbreak of the armyworm during 1940 in Smith, Clay, and Otter Tail counties.

Previous Work on the Family in Minnesota

Aside from the reports of various outbreaks mentioned above, some research work has been done in the state.

Lugger *(19)* listed some species captured at sugar baits at St. Anthony Park, along with scattered dates of collection and classifications as to their abundance.

Some work on *Papaipema nebris* (Gn.) and *P. cataphracta* Grt. was done by H. J. Franklin at University Farm, and was reported by Washburn *(33, 36)*.

Cook *(2)* operated numerous molasses-ferment bait traps at University Farm almost every day from June 18 to September 30, 1920, as well as a few scattered days between April 1 and June 18. Fifteen species were determined, and their flights correlated with meteorological data. Cook *(3)* studied the general biology of the variegated cutworm. Cook *(4)* correlated outbreaks of the armyworm and the variegated cutworm with certain rainfall and temperature conditions.

General Life History and Habits

The number of generations a year varies from one to three. The "summer generation" of a two-generation species refers to the one which arises as eggs from the first flight of moths and terminates as the second flight of moths. The "overwintering generation" pertains to offspring of the second flight of moths, in which one stage or another passes the winter and terminates as the first flight of moths in the growing season.

While genera within a subfamily often vary considerably as to life history, members of a genus often show a tendency to adhere to one particular type. *Papaipema* species emerge as adults in the

fall and overwinter as eggs. *Catocala* species lay eggs in the late summer and pass the winter in that stage. *Septis* species, at least in Minnesota, have predominantly one generation with flights principally in June and July. *Leucania* species, on the other hand, may have one, two, or three generations a year.

Eggs may be laid in masses or singly, and the process may vary from a mere sprinkling during flight to careful deposition on a selected species of plant. Most larvae are solitary feeders on succulent plants. Some larvae are restricted to a single plant species, others to a single genus or family, while others are general feeders. Many of the subfamily Hypeninae feed on dead leaves or rotten wood. Destructive larval feeding habits may be divided into five types: (1) solitary, surface feeders eat plants off at, or slightly above, the ground and sometimes drag the plant to their burrows, although they usually eat but a small portion; (2) climbing species ascend vines, shrubs, trees, etc., and eat the buds, leaves, fruits, and other portions; (3) subterranean species feed on roots and underground parts of stems; (4) armyworms and army cutworms usually feed at the tops of plants and move or "march" when numerous, cleaning up the plants as they go; (5) borers attack stems, stalks, seeds, fruits, etc., and sometimes work as leaf miners during the early stages. Pupation often occurs in the soil, but it may also take place on twigs, within rolled leaves, in debris on the soil surface, or many other places. Adults fly mostly at night, although some may be found in the daytime, especially if the light intensity is low. Many feed upon the nectar of flowers or other plant secretions, while smaller numbers feed on fermenting substances, decaying materials, etc.

Large economic losses are usually confined to a rather small percentage of the species, since the others feed on plants of little or no economic importance. There is always a danger, however, that they may vary their food habits from a wild plant to some closely related cultivated one, and thus any new crop introduced may be in danger. Furthermore, species which under ordinary conditions feed predominantly on wild plants are often "invited" or forced to feed on economic plants; for example, grass-feeding species feed on corn when the sod is broken. Metcalf and Flint *(21)* reported a heavy infestation when wild grasses were cut and spread over a tomato field as mulch. If the margins of fields are weedy, stalk borers will migrate into cultivated fields and will have no choice but to attack the only available plants.

Ecology and Distribution

Crumb (7) pointed out that low temperatures greatly affect seasonal history and distribution, as evidenced by the fact that one-generation species, as a rule, have their metropolis in the north and are resistant to low temperatures in all stages, while multiple-generation species most commonly have their metropolis in the south and are usually resistant to cold in the pupal stage only. High temperatures probably are of great importance in limiting the southern range of many species, although these temperatures, in themselves, do not directly injure the larvae.

Excessive rainfall may drown pupae or larvae, may drive the latter to the surface where parasites and predators may attack them, or may prevent oviposition. Drouth has relatively little effect on population; even when the green food is destroyed, it is probable that diseases are also checked to a similar degree.

Tachinids, Bombyliids, and Metopiids are important Dipterous parasites. Of the Hymenoptera, Braconids, Ichneumonids, and certain Chalcidoidea are of importance. Birds are the most important predators. Many species of beetles, a few ants, bugs, spiders, and mites have been found to reduce numbers to a certain extent. Polyhedral diseases, fungi, bacteria, protozoa, and wilts are of importance in reducing populations, but have little effect unless weather conditions are favorable for their growth.

Topography, Climate, and Vegetative Regions of Minnesota

Because of the relatively recent glaciation over the northern two thirds of Minnesota, and moderately recent glaciation over all except the extreme southeastern corner, the topography may be said to be relatively young. Consequently, thousands of lakes, and few streams, brand it as a relatively poorly drained area. The rich Red River Valley in the northwest was once the bed of glacial Lake Agassiz. Large numbers of swamps with peat deposits are common in the north woods. Glacial moraines are abundant in the south-central region, with a tendency toward level land to the southwest. These numerous swamps and lakes provide optimum conditions for borers of plants common to this environment. The level land, much of which is intensely farmed, provides the opportunity for outbreaks. Because of the Twin City metropolis and the nearby glaciated areas, large numbers of truck and garden crops are available for cutworm attack.

Changes of weather are rapid, and extreme recorded temperatures are 109° F. and —59° F., with a mean temperature of all recorded years of about 41° F. The precipitation becomes increasingly reduced toward the west, with the eastern portion receiving one third to one fourth more than the western. The mean precipitation is about 27 inches a year, and is greatest in the spring. The state's location provides a northern fauna composed mostly of eastern, humid species, although many western, more arid species are common.

The prairie belt roughly covers the southwestern portion of the lower half of the state, and extends upward to Canada through the western tier of counties. The deciduous forest borders the prairie to the east, forming a diagonal belt of from one to four or five counties in width. The remaining eastern two thirds of the northern half of the state is predominantly coniferous forest.

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MATERIALS AND METHODS

Light Trap Studies

One set of 10 light traps of different colors was operated nightly from 8 p.m. to 4 a.m. from at least April 21 to September 22 during 1938, 1939, and 1940 in conjunction with the studies of June beetle flights conducted by Dr. A. A. Granovsky. Although the records of sexes and dates of capture of each night were recorded individually for each light, these catches of the different colors are added into one nightly catch in this study. During the fall of 1940 and the spring of 1939, the lights were operated for longer periods of time, but the extra catches were small and of little or no significance in the studies. These traps were located at the northern edge of the Midland Hills Golf Course, one mile north of University Farm, St. Paul. Across from the traps is a typical oak forest of the glacial Gray-drift which is partially grazed and which has a number of temporary and permanent ponds. The lights consisted of five colors of incandescent bulbs and five colors of gas-tube lights. Each trap consisted of a funnel with bangboards below the light, and a glass cyanide jar attached to the end of the funnel. For brevity's sake, the catches from these traps are designated as "MH."

Another set of lights was operated nightly on the University Farm Campus from 8 p.m. to 3 a.m. from at least April 21 to September 22 during 1938, 1939, and 1940, in conjunction with the flight studies of June beetles conducted by Dr. A. A. Granovsky. All specimens were likewise recorded as to sex and date of capture. These traps consisted of seven incandescent white bulbs, each one operating for one hour each night, with the same type of funnel, bangboard, and cyanide jar as described above. Although the hourly catches of each night were tabulated separately, they are combined in this study. This set of lights was located on a northern slope of a relatively undisturbed and protected area northeast of Green Hall. The vegetation consists of a scattered oak forest with typical undergrowth. These catches are referred to as "UF."

In many cases, the females were dissected to ascertain the condition of the ovarioles.

In 1926 Dr. W. C. Cook initiated light trap studies of this family at University Farm, and this work was carried on through 1927, 1928, and 1929 by Dr. C. T. Schmidt. The data of the following traps have been turned over for incorporation in this study—(1) one light trap operated nightly near the insectary at Univer-

sity Farm from June 30, 1926, throughout nearly all of the flight season (designated as "1926-IL" in the data on species); (2) one light trap operated nightly throughout nearly all of the flight season at the insectary at University Farm during 1927 ("1927-IL"); (3) one light trap operated nightly at the University Farm orchard throughout nearly all of the flight season during 1927 ("1927-OL"), 1928 ("1928-OL"), and 1929 ("1929-OL"). Although the great majority of the specimens was determined by Dr. Schmidt, a considerable number of species was originally determined by Dr. J. McDunnough and a smaller number by Dr. W. C Cook, and Schmidt's determinations were made mainly by comparisons with them.

Graphic representations (plates I-XXII) illustrate all light trap catches of 54 of the more numerous species. The months and days (April 21 to September 21) are shown at the top horizontally from left to right, and the yearly catches are listed (1926-IL to 1940-MH) vertically from top to bottom, with the "IL," "OL," "UF," and "MH" indicating the location of the trap, respectively, as Insectary Light, Orchard Light, University Farm Light, and Midland Hills Golf Course Light, as described above. Horizontally to the right of each year is plotted the daily catch throughout the season (see legend of the Plates for scale used). All specimens taken during 1926, 1927, 1928, and 1929 are indicated in black since no records of sex were kept by Schmidt; all males taken during 1938, 1939, and 1940 are indicated in black, while white squares indicate the females. A summary total of the daily catches for all years (except 1926 which is incomplete) is made on a one-fifth scale.

In cases where the catches of a species were too small to warrant graphic illustrations, and yet were of economic importance or special interest, each species is discussed separately and the number of individuals taken is indicated in parenthesis following the extreme dates of capture. Data on the remaining less common and less destructive species are given in condensed tabular form. In the original manuscript, which is deposited in the University of Minnesota Library, each species is treated in greater detail, and about 250 additional species and races are listed.

Museum Specimen Examinations

All Minnesota and Sioux City, Iowa, specimens in the University of Minnesota Insect Collection are included in this study. All records from northern Iowa, except those from Sioux City, are

from specimens in the Iowa Insect Survey Collection. The great majority of the Iowa collections are from Dickinson County; these were made along West Okoboji Lake, approximately 10 miles below the Minnesota-Iowa line. All records from Brookings, South Dakota, are from specimens in the South Dakota State College Collection. Brookings is located 20 miles west of the Minnesota-South Dakota line. All museum specimen records are of adults, unless stated otherwise.

Hand Collections

Nightly hand collections were made of certain species during 1938 in order to test the reliability of light trap collections as a basis for determination of seasonal history. Part of this phase consisted of collecting as far as possible a constant percentage of the number of specimens taken at lights the previous night, thus making possible a fair comparison of the condition of the ovarioles. Also, nightly collections were made from 8:30 to 9:30 p.m. in which an attempt was made to capture as many of certain species as possible. This provided a measurement of the reliability of the light traps in determining the flights. Hand collections were made with a net on flowers, on fermented molasses baits, and while the adults were in flight, with an attempt to be unbiased and to devote equal time to each of the three collections.

Rearings

Collections of different stages were brought in for rearing. Some rearings were made in the open insectary in salve tins, some in flower pots and lamp chimneys, and a few in out-of-door screen cages. All records of previous rearings were included with the name of the rearer and determiner whenever possible.

Interpretation of Data

The operation of numerous light traps each night throughout the growing season in one locality in Minnesota shows, as a general rule, a definite increase in the number of specimens of certain species during one, two, or rarely three periods. These increased catches, or flights, usually indicate the number of generations. A few exceptions are to be found in species which migrate, aestivate, or hibernate as adults.

If the attraction to light is strong and the species is common, sufficient individuals will be caught so that definite regular flights

will often be apparent. In these cases (Plates I-XXII) a few scattered individuals are caught at the beginning of the flight. Immediately following this they increase in numbers to a peak. Following this the number gradually decreases until the flight ends. Flights rarely follow this ideally, however, since the general trend is usually interrupted by daily fluctuations caused by variations in temperature, moisture, and wind. Usually these adverse factors are of short duration and do not materially interfere with interpretations. However, species can develop rather normally during certain kinds of weather and yet there will be relatively few specimens at lights. This is illustrated by certain flights of *Caenurgina erechtea* (Cram.) and *Autographa falcifera* (Kirby). It is highly probable that these identical adverse conditions will not occur over a period of years, and it is therefore concluded that the operation of light traps for six full years, as was done in this work, is sufficient upon which to base general seasonal histories.

Museum specimens may also be used for flight interpretations, but emergence dates will vary several days with the latitude, and this must be considered in the analysis. Furthermore, miscellaneous collections are usually made mostly during the summer months, and are therefore not so representative of the growing season.

Rearing data are sometimes of little value if the numbers are not large, and natural conditions are hard to duplicate with captured individuals.

Reports of damage, which almost always involve larvae, are usually concerned with mature or nearly mature larvae. The cessation of reports usually indicates that feeding has stopped, and shows pupation has occurred in cases when a flight takes place a few days later.

A number of collections by Lugger *(19)* are also included for aid in interpretations.

TREATMENT OF THE SPECIES[1]

SUBFAMILY ACRONICTINAE

Acronicta americana (Harr.)

The American dagger moth

MUSEUM SPECIMENS EXAMINED: Five males and three females from Crookston, Olmsted County, St. Anthony Park; Dickinson County; Brookings; collected June 15 to July 14.

LIGHT TRAP COLLECTIONS: 1928-OL, August 4 (♂); 1940-UF, June 10 (♂).

LUGGER COLLECTIONS: June 12-25 (4).

REARING DATA AND LARVAL COLLECTIONS: Duluth, larva collected September 2, 1937 (A. E. Pritchard); Lakeland, larva on willow July 26, 1918, pupated August 3, emerged May 29, 1919; St. Anthony Park, larva on willow September 9, 1918, pupated September 16-20, emerged May 31, 1919 (H. J. Franklin).

SEASONAL HISTORY: Fourteen adult records from May 29 to August 4, with half of them in June, indicate a one-generation species. The reared specimens overwintered as pupae.

ECONOMIC IMPORTANCE: Lugger *(20)* reported it as numerous on shade trees "such as maples, etc." He also reported that considerable irritation was caused to tender and soft skin by the larval hairs.

Acronicta tritona (Hbn.)

Lugger *(20)* reported that this species feeds to some extent on leaves of fruit-producing plants.

Acronicta grisea (Wlk.)

MUSEUM SPECIMENS EXAMINED: St. Anthony Park, June 21 ♂; Duluth, ♀.

LIGHT TRAP COLLECTIONS: 1938-UF, June 17 to August 17 (7 ♂, ♀); 1938-MH, June 22 to August 6 (4 ♂).

LUGGER COLLECTIONS: June 9-28 (5).

SEASONAL HISTORY: Eighteen collections ranged from June 9 to August 17, with eight in June, two in July, and eight in August. This probably indicates two generations a year, although the possibility of one prolonged flight is not excluded.

ECONOMIC IMPORTANCE: Lugger *(20)* reported that it feeds to some extent on fruit-producing plants.

[1] For consistency's sake, all scientific names appear as in: MCDUNNOUGH, J. Check list of the lepidoptera of Canada and the United States of America. South. Calif. Acad. Sci. Mem. I:1-275. 1938.

Acronicta funeralis G. and R.

Lugger *(20)* reported that it feeds to some extent on fruit-producing plants.

Acronicta superans Gn.

MUSEUM SPECIMENS EXAMINED: Hennepin County, September 14, ♀.

LUGGER COLLECTIONS: September 14.

SEASONAL HISTORY: Lugger *(20)* stated that larvae appear about the middle of June and again late in September, indicating two generations.

ECONOMIC IMPORTANCE: Lugger *(20)* listed the following food plants—plum, apple, mountain ash, birch, and shadberry, with the latter the favorite food; damage was done only rarely. Two records of damage to apple were recorded in 1937.

Acronicta furcifera Gn.

Lugger *(20)* stated that this species feeds to some extent upon leaves of fruit-producing plants.

Acronicta morula (G. and R.)

MUSEUM SPECIMENS EXAMINED: Three males and two females from Itasca Park, St. Anthony Park, St. Paul; Sioux City; collected May 25 to July 12.

LIGHT TRAP COLLECTIONS: 1938-UF, August 3 (♂); 1939-UF, June 1 (♂); 1939-MH, August 9 (♀); 1940-UF, August 3 (♀).

ECONOMIC IMPORTANCE: Lugger *(20)* recorded this species as feeding to some extent upon leaves of fruit-producing plants.

Acronicta interrupta Gn.

MUSEUM SPECIMENS EXAMINED: Thirteen males and six females from Hennepin County, Olmsted County, St. Anthony Park, St. Paul; Kossuth County; Brookings; extreme dates of collections were April 24 and August 15, with two collections in April, three in May, two in June, two in July, and six in August.

LIGHT TRAP COLLECTIONS: 1928-OL, June 12 to August 15 (3); 1938-UF, August 4 (♂); 1938-MH, September 6 (♀); 1939-UF, June 2 to July 18 (2 ♂).

SEASONAL HISTORY: Extreme collection dates were April 24 and September 6, with two in April, three in May, four in June, three in July, nine in August, and one in September. This indi-

cates two generations a year. Lugger *(20)* stated that larvae become mature about the middle of July.

ECONOMIC IMPORTANCE: Lugger *(20)* reported the following food plants—plum, elm, birch, cherry, and apple.

Acronicta fragilis (Gn.)

Lugger *(20)* reported that this species feeds to some extent upon leaves of fruit-producing plants.

Acronicta hammamelis Gn.

MUSEUM SPECIMENS EXAMINED: Six males and eight females from Crookston, Hennepin County, Ramsey County, St. Anthony Park; Dickinson County; collected June 1 to August 9.

LIGHT TRAP COLLECTIONS: 1929-OL, May 28 to August 30 (24); 1938-MH, June 27 (2 ♂); 1939-UF, June 14 (♀). Total catches, 27 specimens.

SEASONAL HISTORY: Two flights are indicated by the light traps, the first in late May and June, and the second in August.

ECONOMIC IMPORTANCE: Lugger *(20)* reported that it feeds to some extent on leaves of fruit-producing plants.

Acronicta brumosa Gn.

LUGGER COLLECTIONS: July 8-22 (2).

ECONOMIC IMPORTANCE: Lugger *(20)* stated that it feeds chiefly on oak, but also on raspberry, willow, poplar, and hazel.

Acronicta impleta Wlk.

MUSEUM SPECIMENS EXAMINED: Hennepin County, June 20, ♀; Hennepin County, June 24, ♀.

LUGGER COLLECTIONS: June 13-20 (3).

ECONOMIC IMPORTANCE: Lugger *(20)* stated that it feeds to some extent upon leaves of fruit-producing plants.

Acronicta impressa Wlk.

MUSEUM SPECIMENS EXAMINED: Nine males and two females from Hennepin County, Olmsted County, St. Anthony Park; collected June 1 to July 29.

LIGHT TRAP COLLECTIONS: 1927-IL, July 23 (♂); 1928-OL, August 9 (♂); 1939-MH, April 30 (♂).

SEASONAL HISTORY: Lugger *(20)* stated that this is a two-generation species in which the generations overlap, since solitary larvae were found throughout the summer.

ECONOMIC IMPORTANCE: Lugger *(20)* recorded it as common and sometimes injurious. He took it on many plants, including raspberry, blackberry, apple, rose, and hazel.

Acronicta longa Gn.

Lugger *(20)* recorded the food plants as willow, rose, oak, and rarely blackberry, and pointed out the "mechanical" urticating properties of the tubercle hairs.

Acronicta lithospila Grt.

LUGGER COLLECTIONS: March 15 "bred" to July 1 (3).

ECONOMIC IMPORTANCE: Lugger *(20)* stated that it feeds to some extent on leaves of fruit-producing plants.

Simyra henrici (Grt.)

[Often in literature as *Arsilonche albovenosa henrici* (Grt.)]

MUSEUM SPECIMENS EXAMINED: Thirty males and six females from Houston County, Olmsted County, Ramsey County, Sleepy Eye, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected March 12 to August 25.

LIGHT TRAP COLLECTIONS: 1929-OL, 42 specimens; 1938-UF, 22 ♂, 6 ♀; 1938-MH, 151 ♂, 13 ♀; 1939-UF, 9 ♂, 6 ♀; 1939-MH, 69 ♂, 6 ♀; 1940-UF, 16 ♂, 2 ♀; 1940-MH, 62 ♂, 5 ♀. Total catches, 409 specimens; sex ratio, 8.7 ♂ to 1 ♀.

REARING DATA: Anoka, six larvae collected July 4, 1938, pupated July 9 to July 11, emerged July 26 to July 29 (Herbert Knutson).

SEASONAL HISTORY: Plate I indicates two generations a year. The first flight appeared, for the most part, sometime during the last three weeks in May and the first half of June; the second appeared mainly sometime during the last three weeks of July and in August. The majority of the second flight collections was made during the last half of July and the first half of August. The length of the summer generation in 1938 was approximately two months. The flights appeared progressively earlier in the season each year from 1929 through 1939, and the 1940 flight appeared about 22 days later in the season than that of 1939.

Harrisimemna trisignata (Wlk.)

MUSEUM SPECIMENS EXAMINED: Four males and three females from Olmsted County, Rochester; Dickinson County; Brookings; collected June 17 to July 11.

ECONOMIC IMPORTANCE: Lugger *(20)* stated that this species was not common enough to produce much injury, although larvae were frequently found on ash, willow, lilac, and apple.

SUBFAMILY PHALAENINAE (=AGROTINAE)

Euxoa detersa personata (Morr.)

MUSEUM SPECIMENS EXAMINED: Twenty-six males and 19 females from Cass County, Cass Lake, Crookston, Hallock, Middle River, North Branch, Olmsted County, St. Paul; Sioux City; collected July 8 to September 16, with most of them during August and early September. Also, North Branch, larva July 2, 1935 (D. G. Denning), pupated July 25, emerged August 29 (H. S. Telford), ♂; North Branch, larva July 2, 1935 (D. G. Denning), pupated July 25, emerged August 16 (H. S. Telford), ♂.

REARING DATA AND LARVAL COLLECTIONS: Newport, larva collected May 29, 1935; North Branch, larvae collected while attacking potatoes June 30, 1935, adults emerged August 16, and numerous adults collected September 4; Rochester, larvae collected June 11, 1935.

SEASONAL HISTORY: The data indicate a one-generation species, with the majority of adult collections during August and early September. Larvae were recorded as late as July 25.

ECONOMIC IMPORTANCE: Damage to potatoes during 1935 was quite extensive around North Branch, but no other serious outbreaks have been recorded.

Euxoa velleripennis (Grt.)

MUSEUM SPECIMENS EXAMINED: Twenty-four males and six females from Cass County, Cass Lake, Olmsted County, St. Paul; Sioux City; Brookings; collected July 9 to September 31, with the great majority in August and early September.

LIGHT TRAP COLLECTIONS: 1927-IL, 44 specimens; 1927-OL, 180 specimens; 1928-OL, 118 specimens; 1929-OL, 113 specimens; 1938-UF, 5 ♂; 1938-MH, 20 ♂, ♀; 1939-UF, 18 ♂, ♀; 1939-MH, 12 ♂, ♀; 1940-UF, 8 ♂, 2 ♀; 1940-MH, ♂. Total catches, 524 specimens; sex ratio, 12.8 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 30 to September 2 (4).

SEASONAL HISTORY: Plate II shows that it was taken mainly during the last two thirds of August and the first week or two of September, with the peak during the last few days of August or the first few days of September. The 1927 flight appeared slightly later in the season than the other flights.

Four females collected September 1, 1940, were caged out-of-doors and deposited eggs during the following two nights. These hatched September 6, 7, and 8, indicating that this species overwinters as a small larva.

Euxoa scandens (Riley)

The white cutworm

MUSEUM SPECIMENS EXAMINED: Thirty-eight males and seven females from Cass County, Cass Lake, Crookston, Olmsted County, St. Paul; Dickinson County; Brookings; collected June 24 to July 19.

LIGHT TRAP COLLECTIONS: 1927-OL, 41 specimens; 1928-OL, 40 specimens; 1929-OL, 46 specimens; 1938-UF, ♂; 1938-MH, ♂; 1939-UF, 5 ♂, ♀; 1939-MH, 2 ♂; 1940-UF, 4 ♂, ♀; 1940-MH, 2 ♂. Total catches, 144 specimens; sex ratio, 15 ♂ to 1 ♀.

SEASONAL HISTORY: One generation a year is probably indicated by Plate I, with the greater part of the flight having occurred sometime during the latter part of June and in July. However, a small concentration is shown in late August and early September, which may indicate a partial second flight. The main catches appeared progressively earlier in the season each year from 1927 through 1939, while those of 1940 were again postponed in appearance.

Gibson *(15)*, in Canada, stated that moths usually appear in June and during July, and that hibernation takes place as a half grown larva in eastern Ontario; in 1908, most larvae had pupated by the middle of June.

ECONOMIC IMPORTANCE: Lugger *(20)* reported it as a very common and active climber which "sometimes almost entirely destroys the very young foliage of our white and over-cup oaks." It is also destructive to the buds, small fruits, and leaves of fruit trees, and occasionally injures vegetable gardens. Slight damage to tomato leaves has been found at University Farm.

Euxoa messoria (Harr.)

The dark-sided cutworm

MUSEUM SPECIMENS EXAMINED: Twenty-five males and 25 females from Albert Lea, Cass County, Cass Lake, Crookston, St. Paul; Dickinson County; collected July 3 to August 25, and one "reared" May 29 (apparently emerged indoors).

LIGHT TRAP COLLECTIONS: 1926-IL, August 16 to September 13-14 (24); 1928-OL, August 14-26 (3); 1938-UF, September 3 (♂); 1938-MH, July 24 (♀), September 1 (♂); 1939-UF, July 7 (♀); 1940-UF, July 31 (2 ♂); 1940-MH, August 20 (♂). Total catches, 34 specimens.

SEASONAL HISTORY: One generation a year is shown, with adults taken mainly in late July, August, and early September. Cook

(6) stated that it pupates about the first of June in Minnesota.

Gibson *(15)* stated that it often causes injury during May and June in Ontario and Quebec. Crumb *(7)* stated that it overwinters as an egg in Tennessee. Forbes *(13)*, in Illinois, stated that larvae are most abundant in May and disappear by the middle of June; the main flight appears in July, and they are most abundant to September 20.

ECONOMIC IMPORTANCE: This species attacks a wide variety of plants, and often assumes the climbing habit and attacks buds. Crumb *(7)* stated it oviposits almost exclusively in cultivated fields.

Euxoa tessellata (Harr.)

The striped cutworm

MUSEUM SPECIMENS EXAMINED: Twenty-six males and 26 females from Cass County, Crookston, Olmsted County, St. Paul; Dickinson County, Kossuth County, Sioux City; Brookings; Fargo; collected June 22 to August 13.

LIGHT TRAP COLLECTIONS: 1927-IL, 115 specimens; 1927-OL, 149 specimens; 1928-OL, 184 specimens; 1929-OL, 96 specimens; 1938-UF, 15 ♂, ♀; 1938-MH, 26 ♂, 3 ♀; 1939-UF, 32 ♂, 14 ♀; 1939-MH, 14 ♂, 6 ♀; 1940-UF, 22 ♂, 6 ♀; 1940-MH, 6 ♂, 5 ♀. Total catches, 694 specimens; sex ratio, 3.3 ♂ to 1 ♀.

LUGGER COLLECTIONS: July 6 to 22 (2).

REARING DATA: University Farm, 55 larvae caged with lettuce as food on May 24, 1911, very little feeding and many deeper in soil on June 1, larger larvae inactive June 2, at least one pupa June 7, many pupae by middle of June, one emerged June 23, two emerged June 24, four emerged June 25 (Spooner); University Farm, pupated June 17, 1919, three emerged July 14; St. Paul, three emerged July 5, 1919, one emerged July 7; Robbinsdale, mature larvae June 1, 1919, pupated June 16; Robbinsdale, larvae June 7, 1919, first pupa June 12 (W. C. Cook); Anoka County, six overwintering larvae April 2, 1938, collected under bunches of dead grass and reared in outdoor cage, three pupated June 11, three pupated June 12, all emerged between July 3 and 9 (Herbert Knutson).

SEASONAL HISTORY: Plate II indicates a one-generation species with almost all adults taken sometime during the last week in June, July, and the first week in August. The peak for all years was during the middle of July. The flights appeared progressively earlier in the season each year through 1939, while the 1940 flights were delayed in appearance. The females came to lights in about the same proportion throughout the flight.

The reared material, pupated mainly during the second and third week in June, emerged principally during the last few days in June and the first half of July, and overwintered as a larva. Consequently larvae do the greatest damage to gardens in late April, May, and early June.

ECONOMIC IMPORTANCE: Lugger *(20)* reported damage to the foliage of trees and other plants. One garden near University Farm was attacked lightly during the middle of May, 1938. Numerous food plants have been recorded by various workers. It may also climb fruit trees to feed upon the buds.

Chorizagrotis auxiliaris (Grt.)

The army cutworm

MUSEUM SPECIMENS EXAMINED: Twenty-two males and 25 females from Itasca Park, Olmsted County, Ramsey County, St. Paul, West Concord; Kossuth County, Sioux City, Sioux County; Brookings; one collected October 3 (Sioux City), one September 5 (Sioux City), and the remainder from May 8 to July 3.

LIGHT TRAP COLLECTIONS: 1938-UF, May 3 to June 4 (3 ♂); 1938-MH, April 21 to June 5 (7 ♂, ♀).

LUGGER COLLECTIONS: June 11.

SEASONAL HISTORY: A female taken May 20, 1938, was in the preoviposition stage. Adults were taken mostly during May and June, indicating the probability of one generation a year. Cook *(5)* stated that in Montana it pupates late in May, emerges early in July, feeds, aestivates, and then flies again in early September, when it mates and oviposits.

ECONOMIC IMPORTANCE: The greatest damage is produced in the Rocky Mountain region. There is one record of damage in western Minnesota, with no other data available. The larvae normally feed on the surface and may assume the marching habit. A great many plants are attacked.

Chorizagrotis auxiliaris form *agrestis* (Grt.)

MUSEUM SPECIMENS EXAMINED: Three males and six females from Ramsey County, St. Anthony Park; collected "May" and May 8. Also four males and six females from Brookings, one with a pupal case labeled June 18, 1938, and the remainder collected May 25 to June 25 (H. C. Severin). Intermediate stages between this form and typical *auxiliaris* (Grt.) are present.

LIGHT TRAP COLLECTIONS: 1938-UF, May 26 (♂); 1938-MH, May 29 (2 ♀).

Agrotis vetusta (Wlk.)

MUSEUM SPECIMENS EXAMINED: Forty-seven males and eight females from Cass County, Cass Lake, Olmsted County, St. Paul; collected August 14 to September 17.

LIGHT TRAP COLLECTIONS: 1926-IL, August 25 to September 2 (6); 1927-IL, September 1; 1927-OL, September 13; 1938-UF, July 14 (♂); 1938-MH, August 7-27 (4 ♂); 1940-UF, September 7 (♂).

LUGGER COLLECTIONS: August 19 to September 4 (4).

SEASONAL HISTORY: Collection data indicate one generation, with the majority taken during the last half of August and the first part of September.

Crumb *(7)* reported that it overwinters as a larva in Virginia. Slingerland *(27)* reported moths in Massachusetts in August and September, and in New York during July and up to August 25; he found the larvae to overwinter in these states. Since the Minnesota flights coincide rather closely with those of the above states, it is probable that the larva overwinters in Minnesota.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded it as "destructive."

Agrotis gladiaria Morr.

MUSEUM SPECIMENS EXAMINED: Fifteen males and two females from St. Paul; Sioux City; collected August 1 to September 19.

LIGHT TRAP COLLECTIONS: 1927-OL, 1 specimen; 1928-OL, 1 specimen; 1938-UF, 2 ♂; 1938-MH, 31 ♂, 7 ♀; 1939-UF, 31 ♂, 5 ♀; 1939-MH, 35 ♂, 7 ♀; 1940-UF, 86 ♂, 36 ♀; 1940-MH, 105 ♂, 15 ♀. Total catches, 362 specimens; sex ratio, 4.1 ♂ to 1 ♀.

LARVAL COLLECTIONS: St. Peter, two nearly full grown larvae in garden June 5, 1935 (det. C. E. Crumb).

SEASONAL HISTORY: Plate III shows this to be a one-generation species with catches principally confined to the first half of September, and with the peak about September 7. The females showed a slight tendency to come to lights in greater proportions during the first part of the flight. The "early" or "late" springs had little effect upon the time of flight.

Two adult females were caged out-of-doors on September 12, 1938, and eggs were laid two days later; twelve larvae were hatched September 26, which shows this to be the overwintering stage.

Forbes *(12)*, in Illinois, found the larvae destructive from about the middle of April to June 1, with all larvae quiescent by the middle of June and remaining thus for six weeks or more before

pupating; the moths emerge during September and October, with the peak during the latter half of September.

ECONOMIC IMPORTANCE: This surface feeder attacks numerous plants, although it is most commonly found in sod or pasture land and severe damage is therefore rarely reported. It has been most destructive to clover and corn. Some damage was recorded in 1935.

Agrotis venerabilis Wlk.

MUSEUM SPECIMENS EXAMINED: Twenty-five males and eight females from Cass County, Cass Lake, Crookston, Hallock, Olmsted County, St. Paul; Sioux City; collected July 3 to "October."

LIGHT TRAP COLLECTIONS: 1927-IL, 156 specimens; 1927-OL, 49 specimens; 1928-OL, 139 specimens; 1929-OL, 1 specimen; 1938-UF, 19 ♂, 2 ♀; 1938-MH, 19 ♂, 2 ♀; 1939-UF, 203 ♂, 7 ♀; 1939-MH, 113 ♂, 11 ♀; 1940-UF, 190 ♂, 6 ♀; 1940-MH, 56 ♂, 2 ♀. Total catches, 975 specimens; sex ratio, 20 ♂ to 1 ♀.

Plate III shows this species to have one generation a year. The great majority was taken at lights during the first three weeks in September, although a few were taken in August. The peak was during the middle of September, and flights occurred at about the same time each year.

Crumb *(7)* stated that under Sioux City, Iowa, conditions, it passes the winter as a larva; a long aestivating period occurs in the spring; pupation takes place in the fall, followed by emergence in September, October, and November.

ECONOMIC IMPORTANCE: Few records of damage by this common species are to be found. Gibson *(15)*, in Canada, reported injury to vegetable gardens and oats.

Agrotis ypsilon (Rott.)

The black cutworm

MUSEUM SPECIMENS EXAMINED: Twenty-six males and 13 females from Cass Lake, Chisago County, Crookston, Houston County, Marshall County, Olmsted County, St. Paul; Kossuth County, Sioux City; Brookings; collected May 24 to September 17.

LIGHT TRAP COLLECTIONS: 1926-IL, September 2 (3); 1938-MH, June 20 to August 5 (2 ♂, 2 ♀); 1939-UF, August 9 to September 8 (2 ♂, ♀); 1939-MH, June 7 to August 19 (3 ♂, 5 ♀); 1940-UF, July 22 to September 15 (4 ♂, 4 ♀); 1940-MH, July 15 to October 10 (4 ♂, 8 ♀). Total catches, 38 specimens; sex ratio, 15 ♂ to 20 ♀.

LUGGER COLLECTIONS: June 9 to July 19 (3), and August 17 to October 5 (5).

REARING DATA: One pupa collected near St. Paul on October 15, 1940, in an alfalfa field, emerged in laboratory November 1. Adults caged September 27, 1920, laid eggs on dead grass and clover October 23, 1920.

SEASONAL HISTORY: A female dissected August 16, 1940, was in an advanced preoviposition stage, one taken August 8 was nearly spent, while individuals taken October 4 and 5 were spent.

The data appear to indicate two flights a year, but the catches are so small and irregular that differentiation of flights is difficult. Cook *(2)* took specimens on July 15 and 16, which represented the first flight, and from September 18 to 30 (peak September 23-30), which represented the second flight.

The pupa collected October 15 probably indicates overwintering in that stage, although there was no evidence that it would necessarily survive winter temperatures, except that Crumb *(7)* found the pupa to be the only successful overwintering stage in northern Tennessee. The dissected females would indicate that oviposition, in at least some cases, had occurred prior to August 8, and was completed by October 5. Eggs laid October 23 could not have developed to the pupal stage by winter. There is apparently a wide deviation from any seasonal history rhythm.

The American literature on this nearly cosmopolitan species shows that many interpretations of seasonal history have been made. Crumb *(7)* found it to have four generations a year in Tennessee. Lintner *(18)*, in New York, stated that moths were found nightly from late May on through June, July, and August, and on more than half the nights during September; they continued to fly until the last week in October. Gibson *(15)*, in Canada, found moths at about the same time, and collected eggs July 23, 1911, which hatched July 27, and the larvae matured August 20. They entered the soil a few days later and adults emerged September 14 to 18. Gibson thought that there were probably two generations a year. Riley *(23)* reported taking mature larvae at St. Louis about May 1 for several years, and that these did not emerge earlier than July. Forbes *(13)*, in Illinois, stated that the winter is passed chiefly as a larva, with most of the destruction in late May and early June, although there were still some larvae in July. Gillette *(16)*, at Ames, Iowa, reported taking moths each month from May to October, with the extreme dates of May 21 and October 18. Gillette stated (p. 540) "large numbers of females were examined for eggs from September 9th to October 18th, but no well developed eggs were found. From this and the further fact that the moths were taken in the spring it is quite certain

that few or no eggs are deposited in the fall, but that the females hibernate and deposit their eggs in the spring. It is possible, however, that some of the earliest moths do deposit their eggs in the fall and that the worms from these eggs produce moths that appear in July. The moths appearing in May and June I presume to be from belated individuals that did not complete their transformation in the fall."

ECONOMIC IMPORTANCE: Lugger *(20)* reported it as one of the most destructive cutworms in the state, and cited especially the damage to strawberry beds. There are few records of damage directly attributed to this species in Minnesota, although it is probable that many inquiries concerning "cutworms" involve it. The eggs are usually laid in low and wet places, and damage is usually greatest there. The larva is primarily a surface feeder and has a highly developed cutting habit. It seldom occurs in outbreak numbers.

Feltia ducens Wlk.

MUSEUM SPECIMENS EXAMINED: Sixty males and 28 females from Cass County, Cass Lake, Crookston, Hallock, Middle River, Olmsted County, St. Paul; Dickinson County; Brookings; collected July 7 to September 15.

LIGHT TRAP COLLECTIONS: 1927-IL, 1,261 specimens; 1927-OL, 1,751 specimens; 1928-OL, 1,269 specimens; 1929-OL, 2,760 specimens; 1938-UF, 555 ♂, 44 ♀; 1938-MH, 439 ♂, 60 ♀; 1939-UF, 1,159 ♂, 166 ♀; 1939-MH, 364 ♂, 52 ♀; 1940-UF, 729 ♂, 76 ♀; 1940-MH, 204 ♂, 17 ♀. Total catches, 10,906 specimens; sex ratio, 8.3 ♂ to 1 ♀.

LARVAL COLLECTIONS AND REPORTS OF DAMAGE: Albert Lea, mature larvae on onions May 29, 1935 (det. C. E. Crumb); Newport, large larva on raspberry June 7, 1935; St. Paul, larva May 12, 1920 (W. C. Cook); Crystal Lake, larva May 17 (W. C. Cook).

SEASONAL HISTORY: Ninety-three light trap females and 56 simultaneous hand-collected females were taken during the 1940 flight. The flight fluctuations, as well as the ovariole conditions, of the two collections corresponded closely. Laying started during the first week in August and the number of eggs in the females decreased as the flight progressed. Only six of the females taken at light were spent, while nine of the hand-collected individuals were in this condition.

Plate IV shows one generation a year. The moths first appeared in numbers about the last week in July, and became increasingly more abundant in August until a peak was reached

during the latter half of August or early September; the numbers decreased rapidly during the remainder of September. The flights appeared at practically the same time during each year. The females were attracted to lights about equally throughout the flight.

Larval collections ranged from May 12 to June 7, and Cook *(6)* stated that pupation takes place early in June. It must therefore pass the winter as a larva.

Crumb *(7)*, in Tennessee, found the overwintering stage to be a third or fourth instar larva, with these becoming mature and beginning aestivation the last of March and having mostly become inactive by the middle of May. The period of maximum pupation occurs from about the middle of August to about the end of the first week in September, with the period of maximum emergence and trap catches between September 10 and October 10. The greater percentage of the larvae do not enter the soil for aestivation until the middle of June in Illinois, according to Forbes *(13)*, and the last part of June in Canada, according to Gibson *(15)*.

ECONOMIC IMPORTANCE: A wide variety of plants are attacked, although clover, alfalfa, and garden crops are usually the most affected. It undoubtedly is one of the more responsible species for the yearly spring reports of damage by "cutworms." Ordinarily it is a surface feeder, but rarely the climbing habit may be assumed. Slight damage was recorded in 1935.

Feltia subgothica (Haw.)

The dingy cutworm

MUSEUM SPECIMENS EXAMINED: Thirty-five males and four females from Cass Lake, Cook County (Poplar Lake), Crookston, Olmsted County, St. Paul; Dickinson County, Sioux City; Brookings; collected July 23 to September 2.

LIGHT TRAP COLLECTIONS: 1926-IL, August 27; 1927-IL, August 29; 1927-OL, August 29; 1928-OL, August 18; 1938-UF, July 30 (♂); 1939-UF, August 12-27 (9♂, ♀); 1940-UF, July 30 (3♂), August 18 (♂); 1940-MH, August 9 to September 8 (8♂, 3♀). Total catches, 30 specimens; sex ratio, 22♂ to 4♀.

LUGGER COLLECTIONS: July 25 to September 3 (7).

REARING DATA: Clayton, larva May 21, 1918, in cell in soil July 10, pupa found July 31, but may have pupated several days previously, adult September 3 (Marshall Hertwig); Pipestone, larva May 18, 1918, still in that stage July 5, pupa at least by July 31, adult by August 30.

SEASONAL HISTORY: The extreme dates of capture of this one-generation species were July 23 and September 8, and the great majority was taken in August. These catches were slightly earlier in the season than those of *F. ducens* Wlk. Otherwise these two species are very similar (Crumb, 7), and *subgothica* (Haw.) undoubtedly overwinters as a larva, as indicated by the rearing data. However, Crumb did find that *ducens* Wlk. undergoes larval aestivation slightly earlier. Reports of many workers show fewer captures of *subgothica* (Haw.) than *ducens* Wlk., although it probably has a wider range of distribution. Webster *(38),* on the other hand, found *subgothica* (Haw.) to be the more destructive and common in Indiana cornfields in 1889, and in Illinois in 1887.

Feltia herilis (Grt.)

MUSEUM SPECIMENS EXAMINED: Fifty males and nine females from Crookston, Marshall County, Olmsted County, St. Paul; Dickinson County; Brookings; collected July 12 to August 30.

LIGHT TRAP COLLECTIONS: 1927-OL, July 17 to August 1 (8); 1928-OL, July 21 to August 20 (29); 1929-OL, August 7-31 (11); 1938-UF, August 16-19 (2 ♂); 1938-MH, August 27 (♂); 1939-UF, August 23-25 (2 ♂); 1940-UF, August 2-25 (7 ♂, ♀); 1940-MH, August 1-20 (21 ♂, 2 ♀). Total catches, 84 specimens; sex ratio, 33 ♂ to 3 ♀.

SEASONAL HISTORY: A large portion of the collections was made during the second week in August, with the extreme dates as July 12 and August 31. Some consider this to be a race of *subgothica* (Haw.), and certainly the seasonal history data are very similar.

Eighty-four specimens of *herilis* (Grt.), as compared with 30 of *subgothica* (Haw.), were taken at light. Dirks *(11),* at Orono, Maine, took *herilis* (Grt.) in slightly greater numbers than *ducens* Wlk., while the latter outnumbered the former 130 to 1 at University Farm.

Actebia fennica (Tausch.)

The black army cutworm

MUSEUM SPECIMENS EXAMINED: Two males and three females from Hennepin County, Olmsted County, Ramsey County, Sleepy Eye; Fargo, N. D.; collected August 1-12.

LIGHT TRAP COLLECTIONS: 1926-IL, July 31 to August 13 (15); 1927-IL, August 29 (♀), September 6-7 (♀); 1927-OL, July 9 (♂), August 18 (♂).

REARING DATA: Robbinsdale, attacking peas as typical armyworm May 17, 1919, six adults June 20, two adults June 22; St. Paul, reared May 5, 1927 (C. T. Schmidt).

SEASONAL HISTORY: The light trap catches of this one-generation species were from July 9 to September 6-7, and rearing data show that adults emerged as early as June 20 and 22, 1919. The specimen of May 5 may have been reared indoors, or it may represent one of the earliest to emerge. Lugger *(19)* reported that it flew in large numbers from June 29 to August 26, and concluded that it was continuously emerging throughout this period since specimens caught at bait were undamaged; he found the pupal stage to last about 10 days. Cook *(6)* stated (p. 8), "The larvae will appear suddenly in May, devour an enormous amount of vegetation and suddenly disappear." They pupate about May 25, and the adults are found late in June.

Gibson *(15)* stated (p. 28), "From larvae collected in the field near Ottawa we have reared the adult moths, the dates of emergence being from June 15 to June 30. Outside, we have collected the moths from about the middle of June until the middle of September." Larvae overwinter when about half grown, and the injury is done before the end of May or early June.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded a serious outbreak near Hinckley in which the foliage of cherries, poplars, willows, and sumac was the first to be eaten. Following these, almost all plants except a few grasses were attacked. The plants quickly recovered, however, and he concluded that it would only rarely be of much importance.

Spaelotis clandestina (Harr.)

The W-marked cutworm

MUSEUM SPECIMENS EXAMINED: Fourteen males and 16 females from Altura, Hallock, Hennepin County, Houston County, Itasca Park, Minneapolis, New Prague, Olmsted County, Ramsey County, St. Anthony Park, St. Paul, Taylors Falls, Windom; Sioux City; Fargo; collected May 29 to September 9.

LIGHT TRAP COLLECTIONS: 1926-IL, September 21; 1927-IL, June 19-30 (2 ♂, 2 ♀); 1928-OL, July 6-11 (3); 1938-UF, July 25 (♀), August 4 (♂); 1938-MH, June 20 to July 26 (4 ♂, 6 ♀); 1939-UF, July 13 to September 13 (3 ♀); 1940-UF, July 8 to August 21 (4 ♀); 1940-MH, July 2 to September 10 (♂, 6 ♀). Total catches, 34 specimens; sex ratio, 8 ♂ to 22 ♀.

REARING DATA: Robbinsdale, two pupae found around phlox

and rhubarb June 1, 1919, emerged June 18 (W. C. Cook); St. Anthony Park, adult emerged June 13, 1920 (W. C. Cook); St. Paul, two pupae under board June 2, 1938, emerged June 16 (Herbert Knutson), 2 ♀.

SEASONAL HISTORY: All females taken at lights in 1940 on July 2, 7, 8, 15, and August 10, 21, were in the preoviposition stage, while one taken September 10 was full of mature-sized eggs. This indicates a period of prolonged adulthood and a long preoviposition period.

The light trap catches fall into two flights—1927, first flight only, June 19-30; 1928, first flight only, July 6-11; 1938, first flight June 20-25, second flight July 18-August 4; 1939, first flight July 13 (probably), second flight September 12-13; 1940, first flight July 2-15, second flight August 10-September 10. Two flights were also shown by the museum specimens, since 7 were taken in May, 24 in June, 5 in July, 4 in August, and 13 in September.

These data indicate a one-generation species with a prolonged period of adulthood, with greater adult activity principally during June and early July, and again in late July, August, and early September. This same tendency was shown by the catches of Lugger *(19)*, when he took specimens at bait on June 8, 24, 30, August 1, and September 3.

The egg dissections and increased adult activity show that eggs are laid mainly late in the season, and they must hatch before winter and overwinter as larvae in order for them to become adults during late May and June, and pupae by June 1 and 2. Cook *(6)* stated that they pupate in May in Minnesota.

Gillette *(16)*, at Ames, Iowa, reported taking larvae in large numbers during evenings in April and May. Crumb *(7)* constructed a tentative seasonal history from the writings of several workers—the moths emerge early in June and continue on the wing as late as the middle of October, and he deducted that it would be improbable for two generations to take place since the egg stage was found by Gibson to be abnormally long. Riley *(23)* found that the larvae begin to pupate the latter part of May and that the moths begin to appear shortly after the middle of June. Crumb *(7)* stated that the pupal stage requires about a month or five weeks.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded it as very destructive, and *(20)* reported damage to apple buds and currants, but believed it to prefer corn, cabbage, etc. A wide variety of food plants has been recorded by various workers.

Ochropleura plecta (L.)

MUSEUM SPECIMENS EXAMINED: Seventeen males and two females from Hennepin County, Itasca Park, Olmsted County, St. Paul; Dickinson County; Brookings; collected May 26 to August 18.

LIGHT TRAP COLLECTIONS: 1927-OL, 21 specimens; 1928-OL, 30 specimens; 1929-OL, 24 specimens; 1939-MH, 6 ♂, 5 ♀; 1940-UF, 13 ♂, 5 ♀; 1940-MH, 10 ♂ 3 ♀. Total catches, 117 specimens; sex ratio, 2.2 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 2 to August 14 (7).

SEASONAL HISTORY: Plate I indicates two generations a year. The first flights were small and took place sometime during late May, June, and early July, while the more apparent second flights occurred mostly during the last week in July and in August.

Dirks *(11)*, at Orono, Maine, stated (p. 80), "The one brood has an extended period of flight, beginning at the middle of June and ending in early September. However, heavy flights occurred only during the last three weeks in July."

Peridroma margaritosa (Haw.)

The variegated cutworm

MUSEUM SPECIMENS EXAMINED: Thirty males and eight females from Cass Lake, Cook County, Crookston, Hennepin County, Olmsted County, St. Anthony Park, St. Paul, Waseca; Dickinson County, Lyon County; Brookings; collected April 14 to November 17, with three collected April 14 to 22, two in May, seven in July, two in August, two on September 9, and one November 17.

LIGHT TRAP COLLECTIONS: 1926-IL, July 30 to September 22 (18); 1927-IL, August 9; 1927-OL, May 23 to August 16 (3); 1928-OL, August 2-21 (4); 1938-UF, July 29 (♂), August 2 (♂); 1938-MH, July 10 to September 12 (8 ♂, ♀); 1939-MH, May 21 to August 4 (5 ♂, ♀); 1940-MH, July 20 to September 14 (6 ♂, 2 ♀). Total catches, 51 specimens; sex ratio, 20 ♂ to 4 ♀.

LUGGER COLLECTIONS: March 15 to September 19 (6).

REPORTS OF DAMAGE: 1927, Jackson, oats, August 8. 1934, New Ulm, in tomato fruit, August 16; Rochester, with *L. unipuncta* (Haw.), August 17. 1935, Waseca, alfalfa, June 25; Waseca, August 2; Hollandale, celery, August 3; Waseca, flax, August 3; Lewiston, green tomatoes, August 6; Plainview, sweet clover, August 6; Glenwood, August 21. 1936, St. Leo, larvae nearly full grown June 8; Appleton, corn leaves, June 22. 1937, Redwood Falls, sweet clover, June 25; Redwood Falls, June 26; Marshall, sweet clover,

June 28; Ortonville, alfalfa, very abundant, June 28; Dodge Center, alfalfa, June 29; Long Prairie, alfalfa, July 6; St. Peter, clover, July 6; Windom, sweet clover, July 8; Ivanhoe, alfalfa, July 9; Carlos, garden crops, flowers, and alfalfa, July 10; Perham, potatoes, migrating to alfalfa, July 10; Wadena, July 10; Breckenridge, sweet clover, infested heavily until July 10 [pupation]; Bemidji, alfalfa, July 13; International Falls, eating blossoms of alfalfa, July 13; International Falls, blossoms of alfalfa, July 13; Detroit Lakes, alfalfa, July 15; Warren, July 15; Crookston, oats, July 20; Redwood Falls, oats, July 20; St. Paul, tomato fruit, July 20; St. Peter, oats, July 20; Sleepy Eye, oats, July 20; Yellow Medicine County, sweet clover, July 26; Sleepy Eye, oats, July 26; Atwater, July 30; International Falls, July 30; Clarkfield, August 2; Paynesville, August 2; Hollandale, celery and Chinese cabbage, August 12. 1940, Wheaton, tomato fruit, August 14.

REARING DATA: Anoka, 20 larvae collected May 14, 1938, pupated June 1 to 9, emerged June 26 to July 17 (Herbert Knutson); Plainview, larva collected October 15, 1940, pupated in open insectary October 16, brought into laboratory and emerged November 5, ♂ (Don Murray); Stillwater, two larvae collected October 30, 1940 (Herbert Knutson); Waseca, larvae collected June 25, 1935, pupated July 8, emerged July 17; Sioux City, Iowa, larvae September 8, 1918, pupated September 30 (C. N. Ainslie).

SEASONAL HISTORY: This common species is not greatly attracted to lights, although it is probable that the concentration of catches during the last two weeks of July and early August represent the first flight discussed below. Cook *(2)*, in his bait trap studies at University Farm, obtained the earliest moth on May 5, with the first main flight (51 specimens) from June 27 to July 13, with the peak June 29-30; the second flight occurred (90 specimens) August 16 to September 26, with the maximum emergence September 15-20. Cook *(3)* made field observations during the 1919 outbreak and concluded that there are normally two more or less distinct generations, the first flight during July and the second during September. He found overwintering larvae in the field during May, and again very abundantly during the first 10 days of August, and small overwintering larvae of about the third instar in October. Since no adults were taken during the early spring of 1920, he concluded that the majority hibernated as partly grown larvae, and that Lugger's March adult was probably a straggler. He summarized as follows: "The insect hibernates as a partly grown larva or pupa, in the former case the larva works during May, pupating in June. In the latter case the

moth emerges early in the spring, and deposits eggs from which comes a partially overlapping brood. The adults are on the wing in July and deposit their eggs for a second generation working during the early part of August. The adults from this generation lay their eggs during September, and the larvae work in October, hibernating in one of the early instars. It is possible that a portion of the second brood does not emerge in the fall, but winters over." An early outbreak occurred during the early part of August, 1919, in a central belt extending across the state from southeast to northwest, and he correlated it with an abnormally warm and moist environment during June, July, and the first part of August. In the insectary, at about 70° F., and with diurnal fluctuations, egg incubation varied from five to eleven days, with a mean of seven. In the field, the summer larval stage lasted from four to six weeks. A rather indefinite prepupal period covered four to six days, and the pupal period varied from 15 to 30 days during the growing season. The preoviposition period varied from five to seven days, with a mean of about six.

The collections of overwintering larvae May 14, 1938, in which pupation occurred June 1-9 and emergence June 26-July 17, approximated the conditions found by Cook since the emergence dates coincide with the July flight. The capture of two specimens May 23, 1927, and May 21, 1939, as well as the hand collections of wholly gravid females with nearly mature-sized eggs on the latter date, indicates that some individuals overwinter in stages other than the larva. The collection of overwintering pupae, and a gravid female on May 21, suggests overwintering as a pupa, although the possibility of overwintering adults is not excluded.

Table 1 (p. 51) and the reports of damage show that the reports for 1927, 1934, 1935, and 1940 coincide with the findings of Cook *(3)*, when during the first 10 days of August he found larvae produced by July moths. Reports of damage by overwintering larvae occurred on June 8 and 22, 1936, and on June 25, 1935. In 1937 the reports of damage of the two generations of larvae are shown to have overlapped, with complaints coming in during late June, July, and early August. The majority of the reports of 1937 therefore occurred in between the reports of other years. An examination of the locations of these reports shows that the earliest ones were predominantly from the southern and southwestern portions, and that they progressed northward as the season advanced. By July 14 they were predominantly from west-central Minnesota with pupation in at least one instance, and by July 20 they were predominantly from points still farther north.

A new wave of reports from the southern portions appeared July 20, and the remaining reports were confined there with the exception of one northern report from International Falls on July 30. Thus the first wave from south to north was overwintering larvae, and the second group in the southern portions was summer generation larvae. Because of the numerous reports of damage by nearly mature larvae early in the season, and the predominance of collections of overwintering larvae, it is very probable that the larva is the most common overwintering stage.

To summarize, this species undergoes, at least for the most part, two generations a year. Although the majority overwinter as larvae, some probably pass the winter as pupae, and some possibly as adults. This results in any one stage being found over a relatively long period. Overwintering larvae work predominantly in May, June, and the first part of July. Reports of the summer generation larvae have come mainly from July 20 to the middle of August, with this generation usually causing the more severe damage. The first flight appears predominantly in July and early August, and the second in late August and September.

ECONOMIC IMPORTANCE: This is the second most destructive species in the state. The principal crops attacked have been listed above under "reports of damage," and many additional plants have been listed by various workers. Although most of the reports involved field crops, garden crops are probably as commonly attacked, but the latter are less often reported. Unlike most cutworms, it is often found feeding in the daytime and may be occasionally stretched out motionless at the base of a plant. Larger larvae are more inclined to hide in the daytime. They are also fond of the leaves, buds, and fruits of trees, and damage to tomato fruit is very common in the state. It is a bad pest in greenhouses, the infestation occurring either by the importation of the larval, pupal, or egg stage in unsterilized soil, or by permitting the gravid female to fly in through a door or window.

During outbreaks and consequent crowded conditions, it may assume the marching habit, and is frequently found associated with the armyworm.

Graphiphora c-nigrum (L.)

The spotted cutworm, usually in *Amathes* in literature

MUSEUM SPECIMENS EXAMINED: Thirty-five males and 21 females from Albert Lea, Crookston, Hennepin County, Houston County, Olmsted County, Pipestone County, Ramsey County, St.

Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected May 25 to September 19.

LIGHT TRAP COLLECTIONS: 1927-IL, 5 specimens; 1927-OL, 39 specimens; 1928-OL, 24 specimens; 1929-OL, 23 specimens; 1938-UF, 16 ♂, 2 ♀; 1938-MH, 24 ♂, 18 ♀; 1939-UF, 23 ♂, 11 ♀; 1939-MH, 9 ♂, 2 ♀; 1940-UF, 3 ♂, 2 ♀; 1940-MH, 13 ♂, 2 ♀. Total catches, 216 specimens; sex ratio, 2.7 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 11 to September 2 (6).

REARING DATA: University Farm, 125 eggs laid September 27 to October 3 (W. C. Cook); St. Paul, two females caged, eggs laid in scattering masses June 29, 1920 (W. C. Cook); St. Paul, eggs laid June 22 and 24, hatched July 1, larva fifth instar August 6, one pupated August 18, two pupated August 20, adults September 9 (W. C. Cook).

REPORTS OF DAMAGE: Albert Lea, oats, onions, and other garden crops, July 16, 1932 (C. E. Mickel); Austin, wheat, potatoes, July 12, 1932 (C. E. Mickel), "apparently part of a small outbreak in Mower and Freeborn counties"; Ellendale, July 27, 1932 (C. E. Mickel); Faribault, corn, July 25, 1932 (C. E. Mickel); Freeborn County, barley and wheat, July 15-27, 1932 (C. E. Mickel); Mower County, potatoes, onions, flax, oats, garden crops, July 15-27, 1932 (C. E. Mickel); Steele and Waseca counties, potatoes, onions, flax, oats, garden crops, July 15-27, 1932 (C. E. Mickel); Sleepy Eye, oats, July 26, 1937 (Don Murray).

SEASONAL HISTORY: Plate I shows two generations a year, with the first flight principally sometime during the last few days of May, June, and early July. The second flight occurred, for the most part, sometime during the last half of August and the first half of September. The females were attracted to lights in about equal proportions throughout the flights. Egg laying of the first 1938 flight was first apparent May 31, and the number of eggs in the ovarioles gradually decreased as the flight progressed. The length of the summer generation was about 66 days, and the species was exceptional in that the first flight approximated or exceeded the second in size.

Cook *(2)*, by bait catches at University Farm, found the first flight from June 17 to July 8, with the peak June 26-29, and the second from August 21 to September 30, with the peak September 17-24. His bait catches correspond to the light trap catches with the exception of the "early spring" catches of 1938.

Since rearing data show that laying occurred in late September and early October, and the first flight appeared principally in June and early July, it must overwinter as a larva. All reported

damage was produced by summer generation larvae, with reports ranging from July 12 to 27.

Crumb *(7)* believed that there are three generations in the latitude of Clarksville, Tennessee. Dirks *(11)* stated (p. 79), ". . . it is evident that only one extended brood occurs in Maine, unless the straggling flight in September and early October represents a partial second brood."

To summarize for Minnesota, this species overwinters as a larva, pupates early in the spring, and flies principally during June and early July. Reports of damage have been recorded from July 12 to 27 when the larvae were nearly full grown. There is considerable variation in the time of appearance of the second flight, but it is probable that the greatest number of pupae may be found during the first three weeks of August. The second flight is found, for the most part, sometime between the middle of August and the end of the growing season. Egg laying probably occurs principally in September.

ECONOMIC IMPORTANCE: The species is a general feeder, often a serious pest of garden crops, and occasionally a climber pest of trees. It also may take on the marching habit and has been taken in numbers with the armyworm. It will feed in the daytime when crowded.

Graphiphora smithii (Snell.)

MUSEUM SPECIMENS EXAMINED: Six males and four females from Cass County, Cass Lake, Crookston, Marshall County, Olmsted County, St. Anthony Park, St. Paul; collected July 30 to August 16.

LIGHT TRAP COLLECTIONS: 1927-IL, 13 specimens; 1927-OL, 79 specimens; 1928-OL, 23 specimens; 1929-OL, 23 specimens; 1940-UF, 3 ♂. Total catches, 141 specimens.

SEASONAL HISTORY: Plate V indicates one generation a year, with catches appearing during the first week in August, reaching a peak during the last few days of August or early September, and gradually dropping off and disappearing during the second week in September. The 1928 catches appeared about two weeks earlier in the season than those of 1927 and 1929.

Graphiphora normaniana (Grt.)

MUSEUM SPECIMENS EXAMINED: Fourteen males and four females from Hennepin County, Olmsted County, St. Anthony Park; collected July 18 to August 12.

LIGHT TRAP COLLECTIONS: 1926-IL, August 1-15 (9); 1927-IL, September 8; 1927-OL, August 7 to September 5 (25 ♂, ♀, and 11 additional specimens); 1928-OL, August 7-31 (15); 1929-OL, August 2 to September 1 (14); 1939-MH, August 17 (♂); 1940-UF, August 6 (♀). Total catches, 78 specimens; sex ratio, 26 ♂ to 2 ♀.

LUGGER COLLECTIONS: July 31 to August 23 (4).

SEASONAL HISTORY: Ninety-six collections from August 1 to September 8 show this species to have one generation. The great majority was taken during the last three weeks of August and the first week in September.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded it as "destructive" in the state.

Graphiphora badinodis (Grt.)

The spotted-sided cutworm, usually in *Amathes* in literature

LIGHT TRAP COLLECTIONS: 1927-IL, September 6-7, September 9; 1939-UF, September 6-13 (3 ♂); 1940-UF, September 7 (♀).

SEASONAL HISTORY: One generation a year is probably indicated, with the flight mainly confined to September.

Crumb *(7)* recorded one generation in Tennessee, with the winter passed as second or third instar larvae. They begin to mature the latter part of March and begin to enter the soil early in April. Practically all larvae are in the soil by the last of April, and after two weeks they pupate and remain in this stage over a period of more than four months. Moths begin to emerge the very last of September and continue until the third week in October. Flights continue on through until the last of October, with stragglers until the middle of November.

ECONOMIC IMPORTANCE: One record of damage to "garden crops" is recorded in "May" near St. Paul.

Graphiphora bicarnea (Gn.)

MUSEUM SPECIMENS EXAMINED: Thirty males and 25 females from Hennepin County, St. Anthony Park, St. Paul; Dickinson County; Brookings; collected July 25 to August 20.

LIGHT TRAP COLLECTIONS: 1927-IL, 27 specimens; 1927-OL, 167 specimens; 1928-OL, 208 specimens; 1929-OL, 201 specimens; 1939-UF, ♂, 2 ♀; 1940-UF, ♂, ♀; 1940-MH, 4 ♂, 7 ♀. Total catches, 619 specimens.

LUGGER COLLECTIONS: July 30 to August 25 (4).

SEASONAL HISTORY: Plate II indicates one generation, with

moths sometime during late July, August, and early September. The catches of 1928 were made slightly earlier in the season than those of 1929, and both were in advance of that of 1927. The "total of all years" shows that the catches gradually increased through August with the peak during the last week of that month, and that they rapidly fell off during the first week of September.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded it as "destructive."

Abagrotis alternata (Grt.)

MUSEUM SPECIMENS EXAMINED: Five males and three females from Olmsted County, St. Anthony Park; collected September 9-15.

LIGHT TRAP COLLECTIONS: 1927-IL, July 28 (♀); 1927-OL, July 24 (♀); 1929-OL, July 30 (♀); 1940-UF, August 3 (♀), August 5 (♀).

LUGGER COLLECTIONS: July 1 to October 16 (10).

SEASONAL HISTORY: One generation a year may be indicated by 21 collections from July 1 to October 16, although the possibility of two generations cannot be ignored, because of the long range of collections by Lugger.

ECONOMIC IMPORTANCE: Lugger *(19)* recorded it as "destructive."

Ufeus satyricus Grt.

MUSEUM SPECIMENS EXAMINED: Three males and two females from Cook County, Lake County, St. Paul; Sioux City; collected October 8 to April 11.

SEASONAL HISTORY: The female collected April 11 was full of mature-sized eggs, which indicates overwintering as an adult, as does the collection of all of the above specimens in caves during the winter.

SUBFAMILY HADENINAE

Scotogramma trifolii (Rott.)

The clover cutworm

MUSEUM SPECIMENS EXAMINED: Ninety-five males and 30 females from Cass County, Cass Lake, Crookston, Hennepin County, Luverne, Marshall County, Middle River, Olmsted County, St. Anthony Park, St. Paul; Dickinson County; Brookings; collected May 11 to September 22.

LIGHT TRAP COLLECTIONS: 1927-IL, 13 specimens; 1927-OL, 5

specimens; 1928-OL, 12 specimens; 1929-OL, 31 specimens; 1938-UF, 40 ♂, 13 ♀; 1938-MH, 33 ♂, 5 ♀; 1939-UF, 55 ♂, 18 ♀; 1939-MH, 103 ♂, 17 ♀; 1940-UF, 17 ♂, 10 ♀; 1940-MH, 28 ♂, 8 ♀. Total catches, 408 specimens; sex ratio, 3.9 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 9 to September 1 (10).

REPORTS OF DAMAGE AND LARVAL COLLECTIONS: In 1934, Morris, radishes, beets, onions, redroot pigweed, July 30 and August 1; Aberdeen, South Dakota, August 8; Breckenridge, Russian thistle, August 13; Pipestone, August 13; Breckenridge, flax, August 15; Minneapolis, August 17; New Ulm, August 20.

Fridley Sand Dunes, numerous fifth and sixth instar larvae collected during winter of 1938-1939 (Herbert Knutson).

SEASONAL HISTORY: Two generations a year are shown by Plate V, with the first flight much smaller and not represented in certain years. The first flight appeared principally sometime during the last half of May and June, while the second occurred mainly sometime during July, August, and early September. Egg dissections during 1938 also showed two generations, with the number of eggs decreasing as each flight progressed. There was a tendency for the flights to appear progressively earlier in the season each year through 1939, although the 1928 flight may have been slightly more advanced than that of 1929. The 1940 flight was probably behind that of 1939. The flights covered a relatively long period, with relatively few collections made each night; this indicates a loose seasonal history rhythm. The sex ratio was about the same throughout each flight.

Larval collections indicate that it overwinters as a nearly mature larva. Reports of damage from July 30 to August 17 probably involved a late-developing summer generation.

ECONOMIC IMPORTANCE: Peas and clover are usually the most damaged, although many vegetables are attacked. Gibson *(15)* stated that the marching habit is assumed in years of abundance when food becomes scarce.

Polia atlantica (Grt.)

MUSEUM SPECIMENS EXAMINED: Six males and two females from Crookston, Itasca Park, St. Anthony Park, St. Paul; collected May 5 to September 1.

LIGHT TRAP COLLECTIONS: 1927-IL, 18 specimens; 1927-OL, 32 specimens; 1928-OL, 53 specimens; 1929-OL, 180 specimens; 1938-MH, ♂; 1939-MH, 5 ♂; 1940-MH, 3 ♂. Total catches, 292 specimens.

REARING DATA: Brainerd, pupa collected April 23, 1939 (A. E. Pritchard), emerged May 18 (Herbert Knutson), ♂.

SEASONAL HISTORY: Plate V shows two generations, with the first flight having occurred, for the most part, sometime during the last half of May, June, and early July, and the second flight sometime during the last part of July and in August. The flights appeared progressively earlier in the season from 1927 through 1929. The second flight, in general, was larger than the first. The length of the summer generation during 1928 was about 65 days.

Dirks *(11)* found but one generation in Maine, with the flight during June and July.

Polia assimilis (Morr.)

MUSEUM SPECIMENS EXAMINED: Itasca Park, July 12, 1940 (C. E. Mickel), at light, ♂; St. Anthony Park, April 17, 1891, ♂.

LIGHT TRAP COLLECTIONS: 1927-OL, July 12 (♂); 1929-OL, June 11 (♂).

LUGGER COLLECTIONS: April 27.

ECONOMIC IMPORTANCE: Lugger *(20)* recorded this species as feeding on leaves of apple.

Lacinipolia meditata (Grt.)

MUSEUM SPECIMENS EXAMINED: Four males and three females from Cass County, Cass Lake, Minnetonka Lake, Olmsted County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected July 26 to August 4.

LIGHT TRAP COLLECTIONS: 1927-IL, 3 specimens; 1927-OL, 15 specimens; 1928-OL, 43 specimens; 1929-OL, 66 specimens; 1938-UF, 24 ♂, ♀; 1938-MH, 34 ♂, 4 ♀; 1939-UF, 58 ♂, 8 ♀; 1939-MH, 33 ♂, 5 ♀; 1940-UF, 12 ♂, 5 ♀; 1940-MH, 4 ♂, 2 ♀. Total catches, 317 specimens; sex ratio, 6.6 ♂ to 1 ♀.

LUGGER COLLECTIONS: August 5-26 (5).

SEASONAL HISTORY: Plate VI indicates one generation a year with the flight almost confined to August. With the exception of 1927, the flights appeared progressively later in the season each successive year through 1939, and the 1940 flight was again advanced in appearance. With the exception of 1927, this is the exact reversal of the condition found in nearly all species which fly in July, or earlier in the season.

Crumb *(7)* found it to overwinter in Tennessee as a third or fourth instar. Forbes *(12)* found larvae in Illinois from February 28 to May 22, with those of the latter date having entered the soil previous to July 11, and moths having emerged between August 1 and 10.

Lacinipolia lustralis (Grt.)

MUSEUM SPECIMENS EXAMINED: Twelve males and six females from Cass County, Cass Lake, Crookston, Duluth, Hallock, Hennepin County, Itasca Park, Olmsted County, St. Anthony Park, St. Paul; Brookings; collected June 5 to August 16.

LIGHT TRAP COLLECTIONS: 1927-IL, 27 specimens; 1927-OL, 42 specimens; 1928-OL, 81 specimens; 1929-OL, 169 specimens; 1938-MH, 2 ♂, ♀. Total catches, 322 specimens.

SEASONAL HISTORY: Plate VI shows a one-generation species with captures practically confined to a period between the beginning of the second week in June and the middle of July. The flight appeared increasingly earlier in the season from 1927 through 1929.

Lacinipolia renigera (Steph.)

The bristly cutworm

MUSEUM SPECIMENS EXAMINED: One hundred males and 20 females from Cass County, Cass Lake, Cook County, Crookston, Fridley Sand Dunes, Luverne, Minnetonka Lake, New Prague, Olmsted County, Ramsey County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected May 30 to September 22.

LIGHT TRAP COLLECTIONS: 1927-IL, 234 specimens; 1927-OL, 520 specimens; 1928-OL, 465 specimens; 1929-OL, 1,476 specimens; 1938-UF, 11 ♂, 17 ♀; 1938-MH, 161 ♂, 22 ♀; 1939-UF, 508 ♂, 63 ♀; 1939-MH, 357 ♂, 84 ♀; 1940-UF, 732 ♂, 116 ♀; 1940-MH, 402 ♂, 59 ♀, also six males and two females taken October 1 to 9, which are not represented on Plate VII. Total catches, 5,235 specimens; sex ratio, 6 ♂ to 1 ♀.

REARING DATA: Becker, larva in sandy soil (Don Murray), fed lettuce and corn in insectary, pupated May 22, emerged June 3 (Herbert Knutson); Fridley Sand Dunes, two third instar larvae collected under sand reeds at edge of blowout, fed in open insectary on lettuce, cabbage, corn, pupated May 15, emerged May 30 (Herbert Knutson); Houston County, 10 larvae collected in hayfield under bunches of cut hay May 6, 1939, pupated in open insectary May 10-28, emerged May 30 to June 16; University Farm, larva July 24, 1939, fed corn and alfalfa in open insectary, pupated August 4, emerged August 20.

SEASONAL HISTORY: Plate VII shows that the flights of 1938, 1939, and 1940 clearly indicate two generations a year; those of 1927, 1928, and 1929 are more difficult to interpret. In the case of

the latter, adults first appeared relatively late, with the first collection on June 17 in 1927, June 12 in 1928, and June 5 in 1929. In these latter cases, the catches were generally small from the beginning of the flight until about the middle of July, when a very abrupt upswing occurred which resulted in a peak sometime during the last 10 days of July. This peak was followed by a gradual decrease through the first half of August, whereupon there was an increase and another peak which varied from the first part, to the middle, of September. It is apparent that the lights were discontinued after September 2 in 1929, and it is probable that many more individuals would have been captured after that date if light operations had been continued; this would have pushed the peak further into September. In 1938 the first flight occurred during June and early July with the peak during the third week in June. The second flight started during the third week in July and continued to increase to a peak during the last half of August. Following this there was a rapid reduction in catches during the last few days in August and early September. The first catch in 1939 was made on May 28, and the peak of the first flight was attained during the latter half of the first week in June. The catches then subsided to a low ebb during the middle of July. The second flight of 1939 appeared in increasing numbers to a peak during the last half of August, with a few specimens taken in early September. In 1940 the first catch was made on June 1, and many of the first flight were taken during the last 19 days of June and the first three days of July. The second flight reached a peak during the first week in September.

The catches appeared progressively earlier in the season each successive year from 1927 through 1939, and the 1940 collections were again delayed in appearance. The 1940 flight was approximately two weeks behind that of 1939. The females were about equally distributed throughout the flight. The second flight was larger than the first during 1938 and 1939. In 1940 they were about equal in size.

The egg dissections of hand-collected and light trap specimens were comparable throughout the season of 1938. A slight reduction in the number of eggs was apparent as the flight progressed, although a relatively high percentage of eggs was present in the light trap collections. In 1940, dissections revealed oviposition in the second flight to have been first apparent during the second week in August.

The abnormal seasonal history of 1927, 1928, and 1929 is discussed in the "General Consideration of Seasonal History." The

flights of 1938, 1939, and 1940 represent the more common type, since these were more nearly average growing seasons. Rearing data indicate that it overwinters as a larva, and all reared specimens of the overwintering generation pupated May 10 to 28. Emergence of the reared specimens of the first flight (May 30 to June 16) coincided with the light trap catches of normal growing seasons. The length of the summer generation was about 67 days in 1938, 77 days in 1939, and 75 days in 1940, giving a mean of 73. The reared summer generation larva was probably typical, since its emergence date of August 20 coincides with the flight of that year.

Crumb *(7)* found two generations a year in Tennessee. The first moths appear the last of April and continue to emerge until after the middle of June, with a few stragglers as late as the first of July. The summer larvae have a prolonged active period. Emergence of the second flight begins early in August and continues into early October and November. The main light trap catches were made between the middle of September and the end of the first week in October. Forbes *(12, 13)*, in Illinois, reported flights from the latter part of May to the middle of July, and from the middle of August to early October. Most destruction takes place during late April and early May. Dirks *(11)*, at Orono, Maine, found one flight which coincided almost exclusively with July and August, with the peak in August.

To summarize for normal years, this species has two generations a year in Minnesota. It overwinters as a partly grown larva, and the majority of pupae is probably found sometime during the latter three weeks of May and early June. Normally adults first appear about the first of June, attain a peak at lights sometime in June or early July, and mostly disappear at least by the middle of July. Most of the eggs of this flight are laid sometime during the last three weeks in June and early July. The majority of the summer generation larvae is found sometime during late June, July, or early August, and most of the pupae sometime during late July or early August. For the most part, the second flight is taken at light sometime during the last half of August and the first half of September. The eggs hatch in time for the larvae to attain a half-grown size before winter.

ECONOMIC IMPORTANCE: This is one of the most abundant species, and the absence of reported damage can be accounted for only by its feeding to a large extent on some noneconomic plants, or upon hay, grasses, and similar crops which do not show damage readily. A wide variety of food plants has been listed by various

writers. Crumb (7) found Tennessee larvae to be most abundant in old clover fields with a cover of litter, and to a lesser extent in pastures and waste land. It is less subterranean than most cutworms.

Lacinipolia lorea (Gn.)

MUSEUM SPECIMENS EXAMINED: Twenty males and six females from Cass County, Cass Lake, Crookston, Hallock, Hennepin County, Itasca Park, Olmsted County, Ramsey County, St. Anthony Park, St. Paul, Wilkin County; Dickinson County, Sioux City; Brookings; one collected May 26 (Dickinson County), one August 11 (Cass County), and the remainder June 5 to July 26.

LIGHT TRAP COLLECTIONS: 1927-IL, 19 specimens; 1927-OL, 44 specimens; 1928-OL, 74 specimens; 1929-OL, 116 specimens; 1938-UF, 11 ♂, 3 ♀; 1938-MH, 10 ♂, ♀; 1939-UF, 6 ♂, 2 ♀; 1939-MH, 7 ♂, ♀; 1940-UF, 21 ♂; 1940-MH, 5 ♂. Total catches, 320 specimens; sex ratio, 8.5 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 12, 13.

REARING DATA: St. Anthony Park, garden cutworm, pupated May 18, 1919, emerged June 17 (W. C. Cook).

SEASONAL HISTORY: Plate VI shows a one-generation species with collections, with three exceptions, sometime between June 7 and July 14. The reared specimen had overwintered as a larva.

The flight occurred progressively earlier in the season each successive year during 1927, 1928, and 1929, and the 1939 flight appeared earlier than those of 1938 and 1940. Further comparison is not possible, since the catches of the latter three years were much smaller. The greatest apparent variation in seasonal appearance was about 11 days.

Orthodes cynica Gn.

MUSEUM SPECIMENS EXAMINED: Fourteen males and six females from Crookston, St. Paul; Dickinson County; Brookings; collected June 11 to July 20.

LIGHT TRAP COLLECTIONS: 1927-IL, 4 specimens; 1927-OL, 25 specimens; 1928-OL, 45 specimens; 1938-UF, 5 ♂; 1938-MH, ♂, ♀; 1939-UF, 5 ♂; 1940-UF, 24 ♂, 8 ♀. Total catches, 118 specimens; sex ratio, 35 ♂ to 9 ♀.

LUGGER COLLECTIONS: June 9, 13.

SEASONAL HISTORY: Plate V shows one generation a year, with collections mainly confined to sometime in June and the first part of July. No specimens were taken in 1929, the year of the greatest collections of the closely related *oviduca* (Gn.). Although

catches were not large, they appeared progressively earlier in the season each year through 1939, and the 1940 catches were again retarded in appearance. The more easily analyzed catches of 1928 and 1940 appeared about nine days earlier in the season than that of 1927, although these years do not illustrate the extreme conditions in this respect.

Nephelodes emmedonia (Cram.)

The bronzed cutworm

MUSEUM SPECIMENS EXAMINED: One hundred ten males and 13 females from Cass County, Cass Lake, Crookston, Hallock, Olmsted County, St. Anthony Park, St. Paul; Dickinson County; Brookings; collected August 1 to September 20, with the exception of one July 3 from Cass County.

LIGHT TRAP COLLECTIONS: 1927-IL, 165 specimens; 1927-OL, 407 specimens; 1928-OL, 227 specimens; 1929-OL, 129 specimens; 1938-UF, 10 ♂; 1938-MH, 124 ♂, ♀; 1939-UF, 24 ♂; 1939-MH, 50 ♂; 1940-UF, 43 ♂; 1940-MH, 61 ♂, ♀. Total catches, 1,242 specimens; sex ratio, 156 ♂ to 1 ♀.

LUGGER COLLECTIONS: August 25 to September 5 (3).

LARVAL COLLECTIONS: Crystal Lake, nearly mature larvae May 17, 28, 29, 1920 (W. C. Cook); Perham, twigs of trees, June 13, 1940; St. Anthony Park, June 21, 1919 (W. C. Cook); University Farm, nearly full grown working on grass in orchard May 12, 1920 (W. C. Cook).

SEASONAL HISTORY: Plate VIII shows the flight of this one-generation species to be confined mostly to sometime during the last half of August and the first half of September, with the peak during late August or early September. Spent females taken October 12, 1938, indicate oviposition late in the season. Although larval collections were made May 12 to June 21, and many were nearly full grown, the overwintering stage appears to be the egg and small larva.[2]

There was practically no variation in seasonal appearance of the flights, although the first collections of the 1928 flight were made somewhat earlier in August.

ECONOMIC IMPORTANCE: Most of the records of this surface feeder concern attacks upon grass, a type of injury which is less noticeable. It may therefore become of importance when the sod is broken. It may also climb trees and attack the buds.

[2] Walkden found the flight mid-September to early October, hatching in January or February, and larval maturity in late April. WALKDEN, H. H. Notes on the life history of the bronzed cutworm in Kansas. Jour. Kans. Ent. Soc. 10:52-59. 1937.

Nephelodes emmedonia tertialis Sm.

MUSEUM SPECIMENS EXAMINED: Seven males from Cass County, Cass Lake, Crookston, St. Paul, Yellow Medicine County; collected August 3 to September 15.

LIGHT TRAP COLLECTIONS: 1938-MH, August 25 (♂); 1940-UF, August 29 to September 12 (2 ♂); 1940-MH, August 29 (♂).

SEASONAL HISTORY: These data appear to approximate those of *emmedonia* (Cram.).

Morrisonia confusa (Hbn.)

Lugger *(20)* recorded this species as feeding upon apple foliage.

Ceramica picta (Harr.)

The zebra caterpillar

MUSEUM SPECIMENS EXAMINED: Twenty-eight males and five females from Cass Lake, Crookston, Hallock, Houston County, Ramsey County, St. Paul; Dickinson County, Sioux City; Brookings; collected May 22 to August 29.

LIGHT TRAP COLLECTIONS: 1927-IL, 54 specimens; 1927-OL, 58 specimens; 1928-OL, 33 specimens; 1929-OL, 28 specimens; 1938-MH, 38 ♂, 5 ♀; 1939-UF, 8 ♂; 1939-MH, 10 ♂, 2 ♀; 1940-UF, 3 ♂, ♀; 1940-MH, 3 ♂. Total catches, 239 specimens.

LUGGER COLLECTIONS: April 24 and June 5.

REPORTS OF DAMAGE: St. Paul, on peas, July 14, 1938.

SEASONAL HISTORY: Plate VIII shows two generations a year. The first flight occurred sometime during the last half of May, June, and the first week in July. The second flight took place mainly in August, with a few specimens during late July and early September. The length of the summer generation was about 71 days. The second flight was larger than the first.

ECONOMIC IMPORTANCE: Lugger *(19)* reported finding it frequently upon the exposed leaves of cabbage and *(20)* to a lesser extent on apple leaves. Turnips, and other garden crops, and many flowering plants are attacked.

Protoleucania albilinea (Hbn.)

The wheat-head armyworm

MUSEUM SPECIMENS EXAMINED: Seventy males and 22 females from Anoka County, Cass Lake, Crookston, Le Sueur County, Olmsted County, Ramsey County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected May 17 to "October."

LIGHT TRAP COLLECTIONS: 1927-IL, 254 specimens; 1927-OL, 509

specimens; 1928-OL, 932 specimens; 1929-OL, 2,272 specimens; 1938-UF, 673 ♂, 78 ♀; 1938-MH, 418 ♂, 53 ♀; 1939-UF, 578 ♂, 40 ♀; 1939-MH, 205 ♂, 38 ♀; 1940-UF, 685 ♂, 70 ♀; 1940-MH, 145 ♂, 14 ♀. Total catches, 6,964 specimens; sex ratio, 9.2 ♂ to 1 ♀.

REPORTS OF DAMAGE AND REARING DATA: Anoka, pupa collected May 6, 1939 (H. E. Milliron), emerged May 7; Austin, timothy, larvae July 15, 1932; Heron Lake, larva July 8, 1910, one emerged July 23 and three August 2 (Stafford); Lakefield, timothy, larvae July 7, 1932, 15 per cent of field infested.

SEASONAL HISTORY: Egg dissections showed a close correlation between light trap and hand-collected specimens, although there was a slightly larger proportion of hand-collected spent females, and a slightly smaller percentage of hand-collected females which were nearly spent. In 1938, oviposition started during the first week in June and continued throughout the flight with a gradual reduction of eggs. One specimen of the second flight indicated laying during the third week in July, and laying was well under way during the period from July 22 to 31; a similar gradual reduction in eggs occurred as this flight progressed.

Plate IX indicates two generations a year. The first flight was practically confined to sometime during the latter half of May and June, and the peak was attained during the last few days of May or early June. The second flight was taken sometime during July, August, and early September, with the peak sometime during the last half of July or the first half of August. Daily weather fluctuations showed very little effect upon the daily catches, and ideal flight curves were best illustrated in this species.

The second flights appeared progressively earlier in the season each successive year through 1939, and that of 1940 was again delayed. The first flight of 1929, however, occurred slightly earlier than that of 1938. The length of the summer generation was approximately as follows—73 days in 1927, 65 days in 1929, 61 days in 1938, 58 days in 1939, and 72 days in 1940, giving a mean of 66 days. The flight of 1939 appeared about 22 days earlier in the season than that of 1927. The sex ratio remained about the same throughout the flights. The second flight was always much larger than the first.

The pupal collection on May 6, with emergence the following day, makes it appear probable that this specimen had overwintered as a pupa. At least the latter part of April and the first half of May are spent mainly in the pupal stage. Egg laying is well under way a week after the moths start to appear regularly,

as indicated by egg dissections. The summer generation larvae are present in greatest numbers sometime during the last half of June and the first three weeks of July, and pupae are most common sometime during July. Washburn's report *(35)* of larvae being found throughout July probably indicates a retarded seasonal history similar to that of 1927. Egg laying of the second flight is also well under way about a week after the moths appear regularly, and eggs hatch soon afterwards.

Webster *(39)*, in Iowa, reported that larvae work from late in May until well in July, and again from the middle of August until frost, and that it overwinters as a pupa.

ECONOMIC IMPORTANCE: Washburn *(35)* reported a bad outbreak in about 30 localities, with destruction to timothy seed and to hay. The first reports came about the first of July, followed by numerous reports by July 5, and continuing on through July. They occurred in old timothy fields which had not been plowed for several years. He estimated that 80 per cent of the timothy seed crop was destroyed in central and southern Minnesota. Damage was worst at Worthington, on light, sandy soil. Oats, wheat, and corn were attacked following the timothy. Many pupated shortly after the middle of July.

Although one of the most common species in the state, it is rarely of economic importance. It feeds primarily on grasses.

Leucania commoides Gn.

MUSEUM SPECIMENS EXAMINED: Fourteen males and 10 females from Hennepin County, Olmsted County, St. Paul; Dickinson County; Brookings; collected June 25 to August 24.

LIGHT TRAP COLLECTIONS: 1927-IL, 69 specimens; 1927-OL, 470 specimens; 1928-OL, 468 specimens; 1929-OL, 971 specimens; 1938-UF, 15 ♂, 2 ♀; 1938-MH, 12 ♂, ♀; 1939-UF, 59 ♂, 26 ♀; 1939-MH, 32 ♂, 7 ♀; 1940-UF, 43 ♂, 17 ♀; 1940-MH, 70 ♂, 29 ♀. Total catches, 2,291 specimens; sex ratio, 2.8 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 29 and July 25.

SEASONAL HISTORY: Egg dissections revealed little or no decrease in the number of eggs of the light trap females as the flight progressed during 1940. However, the flights of the latter three years were shorter and smaller and coincide with the peaks of the heavier catches of the flights of 1927, 1928, and 1929. It is therefore quite possible that, in years of larger catches, a gradual reduction of the number of eggs occurs as the flight progresses.

Plate X shows a one-generation species, with the great majority taken sometime during the latter half of June, July, and

the first half of August. The peak of catches for all years was July 24, although this is probably biased by the relatively large catches of the relatively late seasons of 1927, 1928, and 1929. Excluding the 1938 flight which was too small for analysis, the peaks of the flights appeared progressively earlier in the season each successive year through 1939, with the 1940 flight again delayed. The 1939 flight was approximately 16 days earlier in the season than that of 1927. A slightly higher percentage of females was taken during the latter half of the flight.

Leucania phragmatidicola Gn.

MUSEUM SPECIMENS EXAMINED: Twenty-six males and 21 females from Olmsted County, St. Paul; Dickinson County, Sioux City; Brookings; collected May 22 to October 9.

LIGHT TRAP COLLECTIONS: 1928-OL, 1 specimen; 1929-OL, 2 specimens; 1938-UF, 15 ♂, 4 ♀; 1938-MH, 64 ♂, 34 ♀; 1939-UF, 79 ♂, 27 ♀; 1939-MH, 154 ♂, 116 ♀; 1940-UF, 97 ♂, 62 ♀; 1940-MH, 72 ♂, 66 ♀. Total catches, 793 specimens; sex ratio, 1.6 ♂ to 1 ♀.

REARING DATA: Anoka County, larva swept from grasses and sedges along edge of pond May 10, 1938, pupated May 18, emerged June 3, ♂ (Herbert Knutson); Hennepin County, larva swept from sedges and grasses along lake May 4, 1938, pupated May 19, emerged June 5 (Herbert Knutson).

SEASONAL HISTORY: Plate X indicates two generations a year. The first flight occurred, for the most part, sometime in June. The second took place mainly in August or early September, with the peak varying from the first part of August to the first part of September. The approximate length of the summer generation was 61 days in 1938, 62 days in 1939, and 77 days in 1940, giving a mean of 67 days.

The first flight of 1939 appeared about ten days earlier in the season than those of 1938 and 1940. The second flight of 1939 was about seven days earlier than that of 1938, and about 22 days before that of 1940. The second flight, in general, was larger than the first.

The sex ratio at lights was about the same throughout the flight. Egg dissections revealed a reduction in the number of eggs as the flight progressed.

Rearing data indicate that it overwinters as a larva.

Dirks *(11)*, at Orono, Maine, found but one flight period which was very similar to that of *commoides* Gn.

Leucania unipuncta (Haw.)

The armyworm, usually in *Cirphis* in literature

MUSEUM SPECIMENS EXAMINED: Seventy males and 51 females from Aitkin, Brownsdale, Cass County, Cass Lake, Crookston, Fairmont, Hallock, Hennepin County, Hibbing, Iron, Itasca Park, Luverne, Olmsted County, Rochester, St. Paul; Dickinson County, Sioux City; Brookings; collected May 20 to October 7.

LIGHT TRAP COLLECTIONS: 1927-IL, 38 specimens; 1927-OL, 81 specimens; 1928-OL, 10 specimens; 1929-OL, 16 specimens; 1938-UF, 146 ♂, 30 ♀; 1938-MH, 102 ♂, 102 ♀; 1939-UF, 61 ♂, 26 ♀; 1939-MH, 36 ♂, 54 ♀; 1940-UF, 143 ♂, 79 ♀; 1940-MH, 64 ♂, 55 ♀, also 20 ♂ and 23 ♀ captured from September 23 to October 10 which are not shown in Plate XI. Total catches, 1,086 specimens; sex ratio, 1.55 ♂ to 1 ♀.

REARING DATA, REPORTS OF DAMAGE, AND OTHER COLLECTIONS: St. Anthony Park, timothy and barley, larva collected July 19, 1909.

1919 rearing records (W. C. Cook)—Mora, pupae collected August 6, two adults August 22, mating August 29; Mora, larvae collected August 6, all pupated by August 10, 17 adults from August 26 to 31; Mora, larva collected August 7, pupa August 12; Mora, larvae collected August 6, pupa August 9, all pupated by August 12, 18 adults August 26 to 30; Mora, three pupae collected August 7, all pupated by August 11, many adults August 23 to 31; St. Paul, eggs laid September 24 to 27; St. Paul, oviposition August 31 to September 15; southern Minnesota, pupae collected August 7 to 13, four emerged August 14 to 16; Rochester, larvae collected in oats August 6, pupa August 13; University Farm, larvae collected on peas with variegated cutworm August 7, all pupated August 12, four adults September 5 to 7; University Farm, pupa collected August 14; Zumbrota, pupa collected August 9.

Aitkin, larva collected July 23, 1931, adults emerged August 17 to 19; Hibbing, larvae collected July 9, 1931, first pupa July 30, all pupated by August 5, five adults August 17 to 19; Iron, larvae collected July 23, 1931, adults emerged August 13 and 19; all reared by C. H. Griffith.

Fairmont, larvae and pupae collected July 1, 1932; Lakefield, larvae collected July 1, 1932; Round Lake, larvae collected July 2, 1932; all collected by C. E. Mickel. Also Freeborn, Faribault, Martin, Jackson, and Nobles counties, first appeared in winter rye on peat soil (Mickel, 22).

Princeton, barley, July 28, 1933, mature larvae damaging 40 acres.

1934 reports of damage—Caledonia, all plants on low ground, June 12; Albert Lea, 800 acres of meadow, June 14; Waseca, meadow, June 21; Perham, June 24; Mora, hay meadow, June 26; Bagley, oats, June 28; Audubon, rye and pastures, June 29; Milaca, meadow, June 29; Grand Marais, hay and small grain, July 4; Aitkin, July 7; Thief River Falls, July 7; Baudette, July 14; Princeton, light infestation in oats, July 28; Virginia, meadows, July 28; Rochester, Sudan grass, August 2; Albert Lea, millet, August 3; Dodge County, Sudan grass, small grain, and corn, August 6; Red Wing, August 6; Fillmore County, August 7; Goodhue County, August 11; New Prague, August 11; Goodhue County, corn, August 13; Waseca County, August 15; Lake Elmo, Sudan grass, corn, cane, August 16, 17; Caledonia, several larvae and one pupa, millet, August 17.

1935 reports of damage—Waldorf, oats, millet, July 31; Albert Lea, oats, moving to corn, August 1; Lewiston, barley, August 1; Plainview, oats, August 1; Plainview, August 1; Red Wing, August 2.

1937 reports of damage—Detroit Lakes, corn, July 15; Detroit Lakes, July 17; Rochester, oats and late corn, July 17; Moorhead, oats, July 19, 12 larvae per square foot; Jordan, oats, July 19; Sleepy Eye, oats, July 20; St. James, oats and corn, July 20; St. Peter, oats, July 20; Fairmont, oats, July 21; Madison, oats, July 21; Aitkin, barley, July 23; Brandon, flax, July 23; Carver County, corn, July 23; Gaylord, July 23, from lodged oats to sweet corn; Mankato, oats, July 23; Stockton, July 23; Windom, sweet clover, July 23; Gaylord, corn, July 24; Alexandria, oats, July 26; Chisago County, corn, July 26; Faribault, seedling black hill spruce, July 26; Sleepy Eye, oats, July 26; Clay County, oats, July 27; Aitkin County, July 29; Hitterdal, July 30; Kanabec County, oats, August 2; Perham, August 2; Carlton, oats, August 4.

1938 reports of damage—International Falls, corn, July 14; Waseca, July 18; Moorhead, July 20; Mahnomen County, July 21; Baudette, July 22; Carlton County, July 22; Kenyon, July 22; Kanabec County, corn, July 25; Clarkfield, corn, larvae July 26, pupae July 28; McIntosh, July 26; Clarkfield, July 27; Cusson, July 27; Becker County, larvae and pupae, July 30; Clay County, larvae and pupae, oats, July 30; Duluth, corn, August 1; Beltrami County, August 3; Clay County, pupae August 3; Kittson County, August 3; Red Lake, August 3; Roseau, August 3; Marshall County, August 4; Hawley, pupae August 7.

Bellingham, larvae July 7, 1939; Madison, larvae July 21, 1939; Beardsley, larvae August 1, 1939; Ralph Stephens' report.

Le Sueur County, larvae July 26, 1940; Rice County, barley and oats, July 26, 1940; Hopkins, larvae July 30, 1940; Perham, larvae on asters, August 9, 1940; Olmsted County, pupa collected October 15, 1940, emerged in laboratory November 4 (Don Murray).

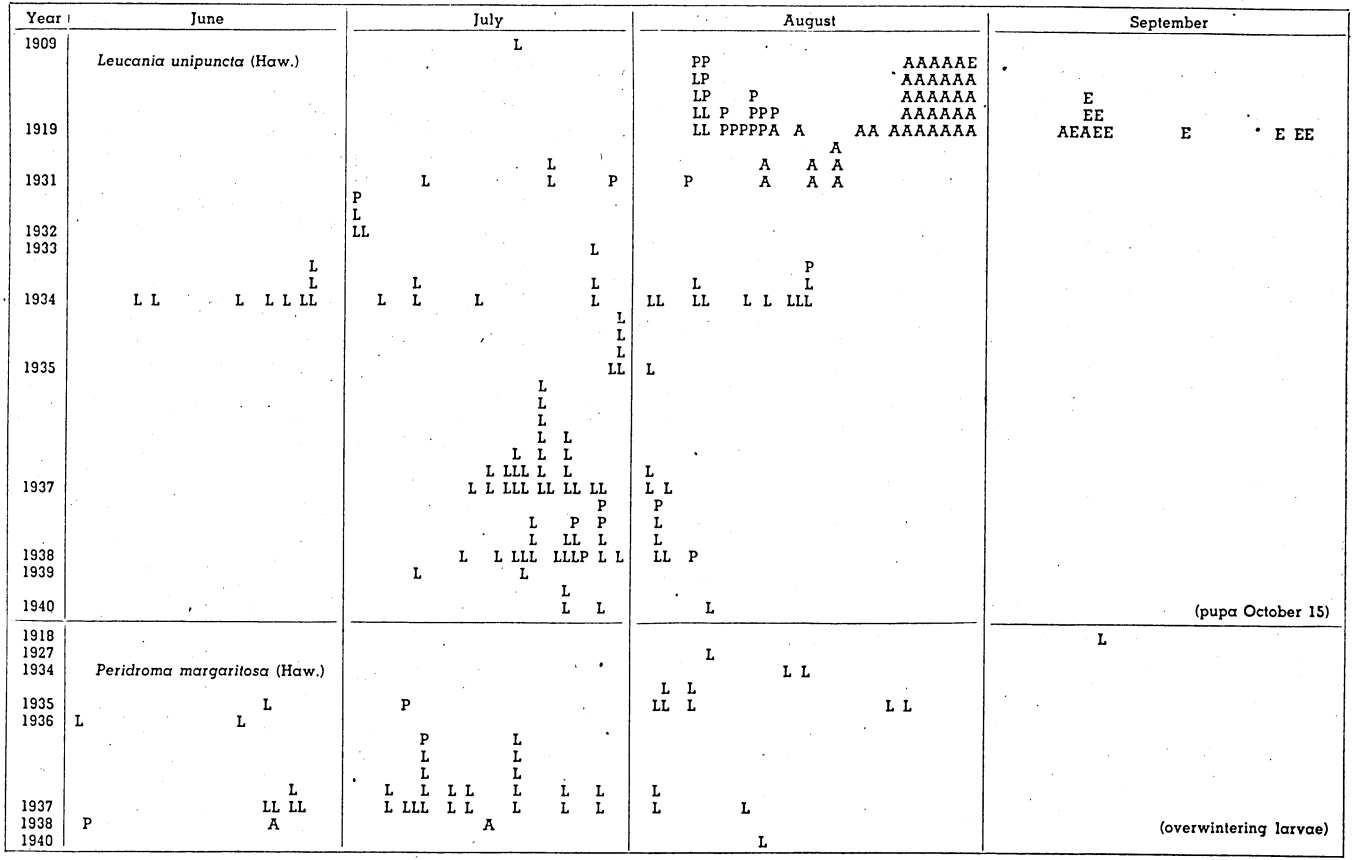
SEASONAL HISTORY: Plate XI indicates a normal two-generation condition, with the probability of three generations during the long growing season of 1939. In addition to the normal pronounced peaks which generally appeared during late June and early July and again in late August and early September, a few scattered individuals were taken early in the season.

The 1927 catches suggest peaks during late June and early July, and again during late August and early September. The catches of 1928 and 1929 were small but appear to approximate those of 1927.

Table 1 indicates that in 1937 the summer generation of larvae was reported during the last half of July and early August; these reports were from southern Minnesota, and they occurred relatively early in the season. Thus the first flight of the following early season of 1938 also appeared relatively early, since it was first taken about the middle of May and continued without great interruptions to a peak during the latter half of June. The resulting summer larvae and the resulting adults also came relatively early, since larvae were again reported at about the same time as in 1937, and since the flight peak at lights was during the first week in August. However, a huge reduction in numbers occurred in the summer generation in the southern portion of the state, since no outbreaks occurred and the second flight was much reduced. Instead, the outbreak took place in northwestern Minnesota (Red River Valley), which had not suffered an outbreak the previous year, and did not suffer another in 1939. This illustrates a situation often cited in the literature, which points out that there are seldom two consecutive yearly outbreaks in a given area. Explanations have been offered which attribute this to the opportunity afforded parasites to build up their populations during an outbreak so that they are present in huge numbers the following year.

The 1939 captures show three general concentrations of catches throughout the abnormally long growing season. The first occurred during the last 10 days of May, the second during the last half of June and July, and the third during the last half of August and the first half of September. Each flight concentration appears to represent a separate generation. The intervals between flights are not believed to have been due to abnormal weather conditions

Table 1. Records of Damage, Larval and Pupal Collections, and Rearings of *Leucania unipuncta* (Haw.) and *Peridroma margaritosa* (Haw.)



E=egg, L=larva, P=pupa, and A=adult. In the case of the records of damage and the larval and pupal collections, only one symbol is used regardless of the number of specimens, and only the dates of transformation from one stage to another are given in the case of the rearing data.

which might have discouraged flights to lights, as other species often exhibited large catches during these same periods. The opportunity for three flights appears to have been provided by: (1) the early seasonal appearance of the second flight of 1938 and the resulting advanced stage of overwintering and opportunity for adults to emerge early in 1939; and (2) the unusually long growing season of 1939, which would allow time for two summer generations. Further evidence of three generations during 1939 is afforded by the fact that the large flight of the last half of June and July (the second concentration of catches) actually appeared later in the season than the first flight catches of 1938 and 1940, although the seasons of the latter two years were relatively late. If this second concentration of 1939 had been the first true flight of the season, it appears that it should have occurred much earlier, as was the case with other species which always have two flights each year.

The first flight of 1940 occurred principally during the last nine days of June and the first 24 days of July, and the second during the last part of August, September, and early October. Thus the first flight of 1940 came slightly more than two weeks later in the season than that of 1938. This retardation was probably due in part to the relatively late season, and also to the late appearance of the extra, third, late flight in 1939, and a consequent overwintering in 1939-1940 in a retarded stage.

Outbreaks occurred (table 1) during 1937 and 1938, when both crops and the seasonal history of the species were well advanced. Although the 1939 season was also well advanced, the modification of seasonal history as described above apparently timed the stages so that most larvae appeared too late for the usual attacks in late July and early August. Field observations during 1940 showed that the larvae came too late to attack the crops, although the late season of that year would normally be expected to retard both the crops and the species to about the same extent.

The length of the summer generation is not clearly indicated by the catches, but it appears to have been slightly more than two months in 1927, about seven weeks in 1938, and about eight weeks in 1940. In 1939, the interval between the first and second catches was about seven weeks, and that between the second and third was probably of about equal duration. The sex ratio to lights was about the same throughout the flights.

Although the larva is the common overwintering stage, the presence of a few scattered individuals early in the season, which were highly gravid in 1938, suggests the probability that some

may pass the winter as pupae or adults. Knight *(17)* thought that pupae could not overwinter successfully in New York.

The dissection of females showed that laying was first evident in 1938 during the second week in June, and that there was a slight decrease in the number of eggs as the flight progressed; most oviposition probably occurred during the last two weeks of June and early July. The second flight of 1938 was so reduced that no definite conclusion could be reached, although the presence of females in the preoviposition stage during the last week of July and the first half of August probably indicated maximum laying during the first three weeks of August. Although no dissections were made until July 1 in 1940, the first flight of that year was so retarded that few individuals were taken until the last nine days in June, and these were, in all probability, mostly in the preoviposition stage. The second flight of 1940, therefore, was also much retarded, with the first sizable catches on August 20. The flight continued on into early October, and there was no indication of oviposition in any of 14 females captured as long as the traps were operated (October 10). An almost continuous rainy period from August 9 to 30 may have intervened in some manner so that the light trap catches were not representative. On the other hand, 92 of the 166 females of the other three flights discussed showed little or no evidence of oviposition, so there was a distinct tendency for light trap collections to be normally highly gravid. Dirks *(11)*, at Orono, Maine, reported that eggs of light trap specimens were "generally . . . in an immature condition and the abdomens filled with fat." Gillette *(16)*, at Ames, Iowa, examined a "great many" females in the fall and found fully developed eggs in only one instance.

Table 1 is a summary of all reports of damage, larval and pupal collections, and rearings listed. The larvae reported as damaging may be assumed to have been principally from half-grown to mature, since few are noticed and reported until they attain that size. These data do not represent the limits of the duration of any stage of the life cycle. The 1919 damage was caused by the summer generation which pupated August 6 to 14, and emerged August 14 to September 7; eggs were laid August 31 to September 27. Damage during 1931 was reported by the summer generation during July, with pupation in late July and early August, and emergence August 13 to 19. The damage in 1932 was caused by overwintering larvae which were reported July 1 and 2, with pupae also found at that time. The outbreaks of 1934 involved reports of overwintering larvae from June 12

to July 14, and of summer generation larvae from July 28 to August 17. The reports of 1935 were confined to the summer generation larvae, with reports from July 31 to August 2. The 1937 outbreak involved relatively early summer generation larvae which were reported from July 15 to August 4. The 1938 outbreak also was concerned with summer generation larvae, which were reported July 14 to August 4, with the majority having pupated by July 27-28, and 75 per cent by August 3.

Lugger *(19)* stated that adults fly in Minnesota from the middle of June until late in September, and that it overwinters as a partly grown larva: "It is usually claimed that there are two annual broods . . . in Minnesota, but we have been unable to verify this statement." Cook *(2)* found two flights by bait trap studies, with peaks from June 28 to July 10, and from August 20 to 30.

To summarize, this species usually undergoes two generations a year, with considerable variation in seasonal history from year to year. Three generations probably occurred in 1939, an unusually long growing season. The winter is most commonly passed as a larva, although a few adults taken early in the season may represent either pupae or adults which overwinter. The overwintering larvae occasionally produce damage to meadows, pastures, grasses, etc., which is reported sometime during the latter part of June and the first few days in July. Attacks by the summer generation were reported sometime from about the middle of July to about the middle of August, depending upon the year; during 1937 and 1938 these reports came in early, and in these instances no reports of damage were received of overwintering larvae. When two generations were undergone, the first flight occurred principally sometime during the last half of June and the first three and one-half or four weeks in July, with the peak during late June and early July. The second flight was correspondingly variable, and occurred mostly between the middle of August and the end of the season, with the peak during late August and early September. When three flights occurred in 1939, the first took place in late May, the second during late June and July, and the third during late August and September.

Economic Importance: Lugger *(19)* reported a state-wide outbreak during the middle of July which continued on through the first week in August; it was worst in the south and southeastern parts of the state (Cook, *4*). He believed the majority to originate in old straw stacks and that they are more abundant in a summer following a wet spring.

Washburn *(32)* found them quite abundant in that year, with timothy most affected. Cook *(4)* reported this outbreak to be rather local in character, with concentrations in the southern portion of the state, and an extension up into the southern part of the Red River Valley.

An outbreak occurred in 1910, which covered about the same region as that of 1906, but it was more severe in the southwestern portion (Cook, *4*).

Cook *(4)* reported the 1919 outbreak as covering the entire southern part of the state and extending up the Red River Valley as far as Crookston.

Ruggles *(25)* reported the 1920 outbreak as having infested the southwestern part of the state south of the Minnesota River, with centers in Yellow Medicine and Lyon counties. Larvae came 10 days earlier than in 1919, following a cool wet spring which retarded the growth of the larvae. No true marching armies were formed, although small armies were found with as many as three or four originating from as many centers in a field. He attributed the failure to march to weather conditions at the time of oviposition, since the latter part of June and the first week in July were wet, making a wide area suitable for oviposition. Oats was especially attacked.

Mickel *(22)* reported small outbreaks in Freeborn, Faribault, and Martin counties in 1927.

Minor outbreaks occurred in 1931 and 1932, which are listed above with the crops attacked.

In 1934 the reports came from most of the state except the northeastern part; the plants and date of reports are listed above.

The 1937 outbreak was concentrated in the southern part of the state and in the western tier of counties as far north as Crookston.

In 1938 a severe outbreak occurred in the Red River Valley, with centers in Clay, Becker, Mahnomen, Clearwater, Pennington, Norman, Polk, and Marshall counties. The majority had pupated by July 27-28 (A. E. Pritchard) and about 75 per cent by August 3 (A. G. Ruggles).

In 1940, there was a minor outbreak in Smith and Clay counties, and a few scattered reports from Otter Tail County. They did not, however, come out until the grain was harvested, and were mostly on canary grass (A. E. Pritchard). A small outbreak also took place in Waseca, Le Sueur, and Scott counties, and this was also mainly confined to canary grass (Don Murray).

Cook *(4)* studied conditions surrounding outbreaks by statisti-

cal methods and determined the moisture and temperature conditions favorable to the species.

Outbreaks in Minnesota usually originate in fields of small grains or grasses where there is a rank growth or where the grain has fallen and lodged; eggs are most commonly laid in lower, damper areas.

Leucania luteopallens Sm.

[Possibly a synonym of *pallens* (L.)]

MUSEUM SPECIMENS EXAMINED: Eighty-eight males and 49 females from Arco, Cass Lake, Crookston, Itasca Park, Olmsted County, Sleepy Eye, St. Anthony Park, St. Paul; Brookings; collected June 5 to August 24.

LIGHT TRAP COLLECTIONS: 1927-IL, 53 specimens; 1927-OL, 144 specimens; 1928-OL, 342 specimens; 1929-OL, 551 specimens; 1938-UF, 38 ♂, 8 ♀; 1938-MH, 31 ♂, 11 ♀; 1939-UF, 40 ♂, 31 ♀; 1939-MH, 71 ♂, 34 ♀; 1940-UF, 117 ♂, 55 ♀; 1940-MH, 51 ♂, 25 ♀. Total catches, 1,602 specimens; sex ratio, 2.1 ♂ to 1 ♀.

LUGGER COLLECTIONS: July 25 to September 4 (7).

SEASONAL HISTORY: Plate XI shows that the seasonal history is very similar to that of *L. renigera* (Steph.), both as to the abnormal seasons of 1927, 1928, and 1929, and the more usual seasons of the latter three years. Egg dissections were also similar, although there was a slightly higher percentage of females in oviposition when the light trap specimens were captured.

SUBFAMILY CUCULLIINAE

Graptolitha bethunei (G. and R.)

MUSEUM SPECIMENS EXAMINED: Seven males and 10 females from Crookston, Olmsted County, Ramsey County, St. Anthony Park; collected September 15 to April 24.

LUGGER COLLECTIONS: September 16 to May 3 (6).

SEASONAL HISTORY: Twenty-three collections from September 15 to May 3 indicate one generation a year. It is probable that at least some overwinter as adults, although these collections, in themselves, do not necessarily show that any specimens found late in the fall survive the winter or that any taken early in the season overwinter as adults. Several workers on this closely related group of species have found that some individuals overwinter as adults, while others pass the winter as pupae.

ECONOMIC IMPORTANCE: Lugger *(20)* reported that it feeds on some "useful plants" in the state.

Graptolitha antennata (Wlk.)

The green fruitworm

MUSEUM SPECIMENS EXAMINED: Twenty-six males and eight females from Olmsted County, Ramsey County, St. Anthony Park, St. Paul; 12 collected September 15 to 19, and 22 on April 4 to 22.

LIGHT TRAP COLLECTIONS: 1938-MH, April 28 (♂), May 15 (♂).

SEASONAL HISTORY: Thirty-six collections from September 15 to mid-May indicate a seasonal history similar to that of *G. bethunei* (G. and R.).

ECONOMIC IMPORTANCE: Lugger *(20)* reported that they bore into apples and eat the foliage of apple, hickory, and other trees.

SUBFAMILY AMPHIPYRINAE

Septis lignicolora (Gn.)

MUSEUM SPECIMENS EXAMINED: Sixty males and 37 females from Cook County, Crookston, Marshall County, Olmsted County, Ramsey County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected June 9 to August 1.

LIGHT TRAP COLLECTIONS: 1927-IL, 29 specimens; 1927-OL, 44 specimens; 1928-OL, 133 specimens; 1929-OL, 70 specimens; 1938-UF, 7 ♂, 3 ♀; 1938-MH, 31 ♂, 11 ♀; 1939-UF, 18 ♂, 5 ♀; 1939-MH, 20 ♂, 9 ♀; 1940-UF, 4 ♂; 1940-MH, 38 ♂, 17 ♀. Total catches, 439 specimens; sex ratio, 2.6 ♂ to 1 ♀.

REARING DATA: Motley, larvae June 11, 1919, pupa June 21 and July 1, adult June 30 (W. C. Cook).

LUGGER COLLECTIONS: June 17 to July 11 (6).

SEASONAL HISTORY: Plate XII shows that the catches, with one exception, were taken sometime during the last half of June, July, or early August, with the peak of all years about the middle of July; this indicates a one-generation species. The flights appeared progressively earlier in the season each year through 1939, and the 1940 flight was again delayed in appearance. The 1939 flight appeared about three weeks earlier in the season than that of 1927.

The sex ratio at light was about the same throughout each flight. Rearing data indicate that it overwinters as a larva. Dissections of the females revealed a gradual reduction in the number of eggs as the flight progressed, with only a small percentage of the females spent.

Septis arctica (Freyer)

The yellow-headed cutworm

MUSEUM SPECIMENS EXAMINED: Four males and five females from Cass County, Cass Lake, Holt, Olmsted County, St. Paul; collected June 18 to August 6.

LIGHT TRAP COLLECTIONS: 1926-IL, August 2-4 (2); 1927-IL, July 5 to August 6 (4); 1927-OL, July 24-26 (2); 1928-OL, July 10-18 (3); 1929-OL, July 27-28; 1940-UF, July 31 (♀).

LUGGER COLLECTIONS: June 16 to August 1 (7).

SEASONAL HISTORY: One generation a year is shown by collections from June 16 to August 6, with the majority in July.

Gibson *(15)*, in Canada, stated that larvae are most abundant in May and June, and that moths are found in June, July, and August.

ECONOMIC IMPORTANCE: This species feeds primarily on the underground portions of grasses, corn, and small grain, and to a lesser extent on vegetables and shrub shoots.

Septis inordinata (Morr.)

MUSEUM SPECIMENS EXAMINED: Eight males from Cass County, Crookston, St. Paul; Dickinson County, Sioux City; collected June 7-25.

LIGHT TRAP COLLECTIONS: 1938-UF, 8 ♂, ♀; 1938-MH, 20 ♂, 4 ♀; 1939-UF, 10 ♂; 1939-MH, 12 ♂; 1940-UF, 15 ♂, 2 ♀; 1940-MH, 2 ♂, 3 ♀. Total catches, 77 specimens; sex ratio, 6.7 ♂ to 1 ♀.

SEASONAL HISTORY: Plate XII shows a one-generation condition with all but one specimen taken in June. The 1939 flight appeared earlier in the season than that of 1938 and 1940.

Agroperina dubitans (Wlk.)

MUSEUM SPECIMENS EXAMINED: Two males and four females from Cass County, Chisholm, Crookston, Olmsted County, St. Anthony Park, St. Paul; collected July 9 to September 2. Also Brookings, June 19, 1921 (H. C. Severin), ♂.

LIGHT TRAP COLLECTIONS: 1927-IL, 10 specimens; 1927-OL, 35 specimens; 1928-OL, 24 specimens; 1929-OL, 18 specimens. Total catches, 87 specimens.

LUGGER COLLECTIONS: July 1 to August 19 (5).

SEASONAL HISTORY: Plate XIV shows one generation a year, with the captures of 1927, 1928, and 1929 confined to late July, August, and early September; the peak occurred around the third week in August. However, the flight peak should be expected

to occur somewhat earlier in the season during normal years, since the seasons of these three years were retarded, and data from other species with similar flights show earlier flights during 1938, 1939, and 1940. The peak of the 1927 flight was about 10 days later in the season than those of 1928 and 1929.

Crymodes devastator (Brace)

The glassy cutworm

MUSEUM SPECIMENS EXAMINED: Fifty-nine males and 35 females from Altura, Cass Lake, Hallock, Hennepin County, Olmsted County, Ramsey County, St. Anthony Park, St. Paul, Taylors Falls; Dickinson County, Sioux City; Brookings; collected June 29 to October 2.

LIGHT TRAP COLLECTIONS: 1927-IL, 285 specimens; 1927-OL, 489 specimens; 1928-OL, 469 specimens; 1929-OL, 178 specimens; 1938-UF, 137 ♂, 18 ♀; 1938-MH, 415 ♂, 73 ♀; 1939-UF, 82 ♂, 21 ♀; 1939-MH, 275 ♂, 41 ♀; 1940-UF, 30 ♂, 11 ♀; 1940-MH, 74 ♂, 19 ♀. Total catches, 2,617 specimens; sex ratio, 5.5 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 2 to August 22 (3).

REARING DATA AND REPORTS OF DAMAGE: Mankato, 10 larvae from cornfield May 17, 1938, fed corn seedlings in open insectary, nine pupated June 19 to 30, remaining larvae died, two adults emerged June 30, three emerged July 4, remaining pupae died (Herbert Knutson); University Farm, 20 eggs deposited in outdoor rearing cages August 19, 1938, six hatched September 1, seven hatched September 3, remainder hatched by September 9 (Herbert Knutson); Long Prairie, larva June 11, 1919, pupated June 21 (W. C. Cook); Park Rapids, larvae collected June 11 and 12, 1919, pupated June 18 and 21; University Farm, larvae attacking wheat June 4, 1919, pupated June 10 (W. C. Cook); Adrian, report of damage (survey report) dated July 10; Luverne, May, 1927, damage; "several counties" (survey report), damage to pastures, alfalfa, timothy, and corn, dated June 23, 1932.

SEASONAL HISTORY: A close correlation between hand-collected and light trap specimens was found in 1938, both as to time of flight and as to condition of egg development; 45 of the latter and 37 of the former were dissected. Egg laying was shown to have started about the first week in August, with a gradual reduction in the number of eggs throughout the flight, and with most of the laying completed by the end of the third week in August.

Plate XIII shows one generation a year. The "total of all years" indicates that more or less continuous flights, which begin in late

June or early July, gradually increase to a peak about the middle of August, and then rather abruptly fall off in numbers and disappear by the end of the first week in September. Each flight appeared at about the same time during the season. The sex ratio at lights remained about the same throughout the season.

Rearing data show that the winter is passed as a small larva and that most individuals probably pupate during the last three weeks in June. Emergence takes place mainly in July and the first few days in August, with the general flight peak during the middle of August. Rearing data and the dissection of females show egg laying to have occurred during the first three weeks of August, with eggs hatching 12 days to three weeks later. The small overwintering larvae do most damage in late April, May, and the first two or three weeks in June.

Crumb *(7)* recorded Sioux City larvae which were collected May 23, pupated the latter part of June, and emerged July 9.

Economic Importance: This is principally a sod-infesting subterranean species which attacks the roots and basal parts of stems. Its destruction is most noticeable following the tearing up of sod, especially in low areas, where it sometimes injures corn severely. Lugger *(20)* reported the destruction of strawberry plants, both by cutting through the base of the plant and by feeding on the leaves. Wheat, alfalfa, and timothy have also been damaged in the state.

Protagrotis niveivenosa (Grt.)

Museum Specimens Examined: Seventeen males and five females from Cass County, Crookston, Duluth, Sleepy Eye, St. Paul; Dickinson County; Brookings; collected July 3 to August 9.

Light Trap Collections: 1927-IL and 1927-OL, 22 specimens; 1928-OL, 39 specimens; 1929-OL, 16 specimens; 1938-UF, ♂; 1938-MH, 18 ♂, ♀; 1939-UF, 18 ♂, ♀; 1939-MH, ♂; 1940-UF, ♂; 1940-MH, 6 ♂. Total catches, 124 specimens; sex ratio, 45 ♂ to 2 ♀.

Seasonal History: Plate XII shows a one-generation species with flights having occurred, for the most part, sometime during the last half of July and in August. The 1928 flight appeared slightly more than two weeks later in the season than that of 1927, while the remaining flights were approximately one week in advance of that of 1927.

Luperina stipata (Morr.)

Museum Specimens Examined: Olmsted County, ♀; Sioux City, July 24, 1923 (C. N. Ainslie), ♀.

LIGHT TRAP COLLECTIONS: 1927-OL, July 28 to September 16 (3 ♂, 3 ♀); 1928-OL, July 20 to August 28 (5 ♂, 2 ♀); 1929-OL, July 28 to August 29 (7 ♂, ♀).

LUGGER COLLECTIONS: August 15.

SEASONAL HISTORY: Twenty-three collections were taken from July 20 to September 16, with the majority in August; this indicates a one-generation species. Decker *(9)*, at Ames, Iowa, found that moths emerge during the fore part of August. The overwintering stage is the egg, which hatches during late April or early May. Pupation occurs after a growing period of 10 to 14 weeks. The light trap data correspond closely to that found by Decker, so it is probable that the seasonal history is very similar in Minnesota, although there are undoubtedly slight modifications due to the shorter growing season.

ECONOMIC IMPORTANCE: Decker *(9)* reported damage to corn in northern Iowa, including several counties bordering Minnesota, and it is probable that Minnesota suffers at least slight damage. He found the common slough grass, *Spartina michauxiana* Hitchs., was the natural host. "Dead heart" is the resulting corn damage.

Oligia fractilinea (Grt.)

The lined stalk borer

MUSEUM SPECIMENS EXAMINED [form *vulvivaga* (Morr.) included]: Eighty males and 30 females from St. Anthony Park, St. Paul; Dickinson County; collected July 24 to September 6.

LIGHT TRAP COLLECTIONS: 1927-IL, 17 specimens; 1927-OL, 105 specimens; 1928-OL, 39 specimens; 1929-OL, 18 specimens; 1938-UF, 22 ♂, 2 ♀; 1938-MH, 13 ♂, 4 ♀; 1939-MH, 2 ♂, 4 ♀; 1940-UF, 3 ♂, 4 ♀; 1940-MH, 2 ♂, 3 ♀. Total catches, 238 specimens; sex ratio, 42 ♂ to 17 ♀.

LUGGER COLLECTIONS: June 19 to August 25 (10).

SEASONAL HISTORY: Plate XIV shows one generation a year, with catches taken, for the most part, sometime during the latter half of July and in August. The flights appeared progressively earlier in the season in the following sequence—1927, 1929, 1928, and 1938; the catches of 1939 and 1940 were too small for accurate classification.

Oligia fractilinea form *misera* (Grt.)

LIGHT TRAP COLLECTIONS: 1927-IL, August 3 (♂); 1927-OL, August 21 (♂); 1928-OL, August 5 (♀), August 13 (♂); 1938-UF, August 12 (♂).

LUGGER COLLECTIONS: August 2.

Archanara subflava (Grt.)

MUSEUM SPECIMENS EXAMINED: Three males and 18 females from Cass Lake, Crookston, Marshall County, Olmsted County, St. Paul; Dickinson County; Brookings; collected June 16 to September 16.

LIGHT TRAP COLLECTIONS: 1927-IL, 16 specimens; 1927-OL, 4 specimens; 1928-OL, 71 specimens; 1929-OL, 10 specimens; 1938-UF, 22 ♀; 1938-MH, ♂, 57 ♀; 1939-UF, 4 ♂, 11 ♀; 1939-MH, 29 ♀; 1940-UF, ♂, 5 ♀; 1940-MH, 2 ♂, 6 ♀. Total catches, 239 specimens; sex ratio, 1 ♂ to 16.2 ♀.

SEASONAL HISTORY: Most striking in this species was the extreme reverse of the usual sex ratio. In many instances the ovarioles within a female varied widely as to the development of the eggs, although practically all eggs within any one ovariole were of the same size. This probably indicates that oviposition extends over a relatively long period. This is further supported by the fact that the abdomens of 71 of the 79 females taken during 1938, and all 11 females taken during 1940, were completely filled because of the predominance of many mature-sized eggs. The remaining nine females taken during 1938 (July 30 to August 30) had laid about half of the eggs.

Plate XIV shows this species to have one generation a year, with flights mostly during the last half of July, August, and early September. Because no spent females were taken, it appears that either the females die before having laid many of their eggs, or that at least the great majority change phototropic response when they have laid part of their eggs.

The flight is spread over a relatively long period considering the number of specimens taken, and with the possible exception of 1939-MH, there is no peak. There is no noticeable difference in the seasonal appearance of the flights, although the 1928 flight may have been slightly advanced.

Apamea velata (Wlk.)

MUSEUM SPECIMENS EXAMINED: Six males and nine females from Hennepin County, Olmsted County, Ramsey County, St. Anthony Park, St. Paul; Brookings; collected June 16 to August 6, with all but four in July.

LIGHT TRAP COLLECTIONS: 1927-IL, 14 specimens; 1927-OL, 20 specimens; 1928-OL, 92 specimens; 1929-OL, 15 specimens; 1940-MH, 2 ♂, 4 ♀. Total catches, 147 specimens.

LUGGER COLLECTIONS: June 29 to August 2 (5).

SEASONAL HISTORY: Plate XIV shows one generation a year with catches sometime between July 5 and August 6. Other data extend this range from June 16 to August 6. The majority of all collections was made during the last three weeks of July. The 1928 catch appeared one or two weeks earlier in the season than that of 1927, and probably earlier than that of 1929. The remaining catches were too small for determination in this respect.

Apamea americana Speyer

MUSEUM SPECIMENS EXAMINED: Eight males and three females from Cass County, Cass Lake, Cook County, Crookston, Hennepin County, St. Paul; Brookings; collected July 3 to September 6, with the majority in late July and early August.

LIGHT TRAP COLLECTIONS: 1927-IL, 46 specimens; 1927-OL, 453 specimens; 1928-OL, 581 specimens; 1929-OL, 296 specimens; 1938-UF, 8 ♂; 1938-MH, ♂, 2 ♀; 1939-UF, 42 ♂, 7 ♀; 1939-MH, 4 ♂; 1940-UF, 24 ♂; 1940-MH, 4 ♂. Total catches, 1,468 specimens; sex ratio, 9.2 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 29 to August 6 (5).

SEASONAL HISTORY: Plate XV shows this to be a one-generation species with catches made principally sometime during the last three weeks of July, August, and early September. The majority was taken during late July and early August. Relatively little difference in seasonal appearance among the various years is shown, although the 1928 flight was in advance of that of 1927 and 1929, and the 1939 flight appears to have been slightly in advance of that of 1928.

Papaipema furcata (Sm.)

MUSEUM SPECIMENS EXAMINED: Three males and one female from Olmsted County; Sioux City; collected September 7 to 27.

REARING DATA: Owatonna, borers in ash July 15, 1908 (A. G. Ruggles), two larvae burrowed in ground July 22, one moth emerged August 28; Owatonna, larvae collected July 20, 1908, several had pupated by July 30, some emerged August 31; St. Anthony Park, adult emerged August 31, 1908 (A. C. Baker).

SEASONAL HISTORY: This one-generation species, with the typical seasonal history of the genus, was collected as a larva on July 15 and 20, and emergence occurred on August 28 and 31.

ECONOMIC IMPORTANCE: Washburn *(33)* reported the destruction of the new growth of hundreds of young ash trees in a nursery.

Papaipema purpurifascia (G. and R.)

The columbine borer

MUSEUM SPECIMENS EXAMINED: Hennepin County, September 1, ♂.

LIGHT TRAP COLLECTIONS: 1926-IL, September 2 (2); 1927-IL, August 28 to September 15 (3 ♂, ♀); 1927-OL, August 24 to 31 (12); 1929-OL, August 22 to 29-30 (6); 1938-UF, August 26 to 27 (2 ♂); 1938-MH, August 27 (♂); 1939-UF, September 4 (♂); 1939-MH, August 20 (♂); 1940-UF, September 20 (♂).

REARING DATA AND REPORTS OF DAMAGE: Detroit Lakes, columbine roots, July 26, 1938; Dorset, columbine roots, July 19, 1938; July 30 (larvae); Northfield, columbine roots, one pupa and four larvae collected July 30, 1940, three pupated July 31 to August 4, one emerged August 18.

LUGGER COLLECTIONS: September 4.

SEASONAL HISTORY: Reports of damage extended from July 19-30, with pupation during late July and early August. One emergence was recorded August 18, and 32 adult collections were made from August 20 to September 20; this indicates one generation a year.

ECONOMIC IMPORTANCE: The larva bores inside the columbine stem and usually works its way to the roots. Actual economic loss is small.

Papaipema cataphracta (Grt.)

MUSEUM SPECIMENS EXAMINED: Olmsted County (C. N. Ainslie), 3 ♂; St. Paul, September 11, 1935 (A. A. Granovsky), ♀.

LIGHT TRAP COLLECTIONS: 1927-OL, September 14 (♂), September 16 (♀); 1939-MH, September 15 (♂).

REPORTS OF DAMAGE: St. Paul, hollyhock, July 19, 1937.

SEASONAL HISTORY: Washburn *(33, 36)* reported that larvae were found from July 14 to August 24. Pupation ranged from August 5 to 23, and emergence ranged from August 30 to September 27. One generation a year is indicated.

Papaipema nebris (Gn.)

The stalk borer

MUSEUM SPECIMENS EXAMINED: Four males and one female from Crookston; Dickinson County, Sioux City; collected August 16-19.

LIGHT TRAP COLLECTIONS: 1927-IL, September 14-15 (2); 1927-OL, September 5-15 (♂); 1928-OL, August 16; 1938-MH, August

25 (♂), September 3 (♀); 1939-UF, September 4-6 (2♂); 1940-UF, September 5-29 (3♂).

REPORTS OF DAMAGE: Graceville, tomato, July 5, 1932; St. Paul, July 6, 1932. Appleton, corn, July 18, 1933. Concord, corn, July 26, 1935. Le Sueur, corn, July 14, 1936; St. Paul, golden alder, June 17, 1936. In 1937, Lewiston, July 13; Hollandale, potato, July 16; Garden City, corn, July 19; Lakefield, wheat, July 19; Hawley, hollyhock, July 27.

In 1938, Windom, golden elderberry, June 30, 50 per cent damage; St. Paul, red raspberry, July 5; Moorhead, corn, July 6; Preston, corn, July 7; Red Wing, July 24; Morris, ragweed, July 25.

In 1939, Blue Earth, oats, June 29; Windom, corn, June 29, heavily infested around border of field; Watonwan County, July 2; Nobles County, corn, July 5; Spring Valley, corn, July 11; Lamberton, corn, July 19; Red Wing, corn, July 19; Sedan, July 22; Fairmont, corn, July 24; Jackson, corn, July 24; Lakefield, corn, August 19.

In 1940, Redwood Falls, oats and barley, July 3; Clarkfield, corn, July 8; Milan, potatoes, July 8; Blue Earth, July 11; Worthington, August 24, pupa in cornstalk; Lucan, pupa in cornstalk September 3, adult emerged September 11.

SEASONAL HISTORY AND ECONOMIC IMPORTANCE: Thirteen adult collections were made from August 16 to September 29, with an additional specimen labeled "August." This indicates the typical one-generation condition of this genus. Reports of damage ranged from June 17 to August 19, with four reports in June, 26 in July, and one in August. Pupae were found from August 24 to September 3. Damage was predominantly to corn, with wheat, oats, barley, raspberry, potato, and some ornamental plants reported once or twice.

Lugger *(20)* reported it as very common and injurious in 1898, when it destroyed much wheat and straw; it also attacked raspberry, blackberry, fruit of strawberry, potato, spinach, aster, apple twigs, and bored into the stems of tomatoes.

Washburn *(28)* reported damage to hollyhock, tomato vines, catalpa, and golden glow, and stated that it had previously worked on potato, aster, dahlia, castor bean, and twigs of apple, peach, and currant. Washburn *(29)* reported damage during 1905, and in 1906 *(30)* added wheat, corn, oats, phlox, lily, ragweed, and pigweed to the list. Franklin (Washburn, *33, 36*) found larvae at work on July 3, 1908, when he first started the study, and continued to find them up until August 18. Eggs were laid September

17 of that year and they hatched May 20 to 29 of the following year. The young larvae worked in seedling plants as leaf miners, many boring into stalks by June 4, and all had "disappeared" by August 17. The first pupa was found August 8, and emergence ranged from August 24 to October 1.

Decker *(10)* found that it normally feeds on ragweed, but listed 176 species of plants which were known to be attacked. Consequently the greatest infestation is along fences, except when the whole field is weedy.

Macronoctua onusta Grt.

The iris borer

MUSEUM SPECIMENS EXAMINED: St. Paul, September 15, 1938 (Herbert Knutson), ♂.

LIGHT TRAP COLLECTIONS: 1938-MH, September 16 (♂); 1940-MH, September 8 (♂).

REARING DATA: St. Paul, eight larvae collected July 28, 1938, on August 12 three had pupated while three were still active and two had formed earthen cells; of the first three, one emerged August 30, and two August 31. Also, numerous rearings were made by Milliron, Knutson, and Medler, which are summarized below.

SEASONAL HISTORY: One generation a year is indicated by numerous adults reared from August 30 to September 21. In 1938, larvae were reported as early as June 15, and a few were active as late as August 12. Pupae were present at least as early as August 10, and pupation was reported on August 12 and 14. Moths were seen ovipositing on September 18, 1938, and numerous rearings have shown that the winter is passed as an egg.

ECONOMIC IMPORTANCE: The early injury is to the iris leaves, but the larvae later work their way to the lower portions, and often burrow in the bulbs. The bulbs are then rendered unsightly and worthless. Severe damage was caused at a nursery in West St. Paul in 1938, as well as to numerous private gardens during 1938 and 1939.

Amphipyra pyramidoides Gn.

MUSEUM SPECIMENS EXAMINED: Five males and four females from Hennepin County, Itasca Park, Olmsted County, St. Anthony Park, St. Paul; Sioux City; collected August 20 to September 4. Also Hennepin County, collected May 19, ♂.

LIGHT TRAP COLLECTIONS: 1926-IL, August 2; 1927-IL, September 1 to 3; 1928-OL, August 20; 1929-OL, August 28 to 29-30; 1938-MH, September 10 (♂); 1939-UF, July 29 to September 13 (2♂,

♀); 1939-MH, August 18 (♀), 30 (♂); 1940-UF, August 24 to September 7 (3♂); 1940-MH, August 24 (♂).

LUGGER COLLECTIONS: August 20 to October 3. (4).

SEASONAL HISTORY: One generation a year is shown by 29 collections from July 29 to October 3. The collection of May 19 probably represents an overwintering adult. Lugger *(20)* found them hiding as adults under bark late in the season, and stated that they emerge the latter part of July or early in August.

ECONOMIC IMPORTANCE: Lugger *(20)* reported it feeding on plum, grape, raspberry, strawberry, and several other cultivated and wild plants.

Amphipyra tragopoginis (L.)

MUSEUM SPECIMENS EXAMINED: Olmsted County (C. N. Ainslie), ♂; Sioux City, Iowa (C. N. Ainslie), ♂.

ECONOMIC IMPORTANCE: Lugger *(20)* reported finding one specimen on grape at Rochester.

Platysenta videns (Gn.)

MUSEUM SPECIMENS EXAMINED: Four males and three females from Crookston, St. Paul; Dickinson County; collected May 29 to August 12.

LIGHT TRAP COLLECTIONS: 1927-IL, 4 specimens; 1927-OL, 3 specimens; 1928-OL, 2 specimens; 1938-UF, 21♂, 3♀; 1939-UF, 10♂, 4♀; 1939-MH, 9♂; 1940-UF, 19♂, 4♀; 1940-MH, 2♂. Total catches, 81 specimens; sex ratio, 5.5♂ to 1♀.

LUGGER COLLECTIONS: July 22 to August 3 (4).

SEASONAL HISTORY: Plate XVI shows two generations a year with the first flight taken, for the most part, sometime during the last week in May and the first three weeks of June. The second flight was taken mostly during the last half of July and the first three weeks of August. The length of the summer generation was about 50 days. The second flight, in general, was larger than the first.

Platyperigea extima (Wlk.)

MUSEUM SPECIMENS EXAMINED: Fifty males and 17 females from Cass County, Cass Lake, Crookston, Hennepin County, St. Anthony Park, St. Paul; Sioux City; Brookings; Fargo, North Dakota; collected June 18 to September 15-21.

LIGHT TRAP COLLECTIONS: 1927-OL, 42 specimens; 1928-OL, 3 specimens; 1929-OL, 2 specimens; 1938-UF, 24♂, 7♀; 1938-MH,

♂; 1939-UF, 7♂, 6♀; 1940-UF, ♂, ♀. Total catches, 94 specimens; sex ratio, 33♂ to 14♀.

SEASONAL HISTORY: Plate XII indicates, at least for the most part, a two-generation condition. The first flight occurred mainly sometime between June 7 and July 2, and the second between August 17 and September 5. It is probable that the summer generation is shorter than it appears in the plate, since the "late season" of 1927 provided the only sizable catch of the second flight, while the "early season" of 1938 produced the only large catch of the first flight. The possibility of three generations during 1939 is indicated.

Crambodes talidiformis Gn.

MUSEUM SPECIMENS EXAMINED: Twenty males and nine females from Cass Lake, Olmsted County; Sioux City; Brookings; collected May 25 to September 3.

LIGHT TRAP COLLECTIONS: 1927-IL, 7 specimens; 1928-OL, 1 specimen; 1938-UF, 2♂; 1938-MH, 4♂, ♀; 1939-UF, 2♂, 8♀; 1939-MH, 5♂, 7♀; 1940-UF, 6♂, 8♀; 1940-MH, 4♂, ♀. Total catches, 56 specimens; sex ratio, 23♂ to 25♀.

SEASONAL HISTORY: Plate XVI shows two generations a year with the flights poorly defined. The first flight was taken mainly during the last week in May and in June, and the second mainly during the last half of July and August; a few of the latter flight were taken in early September. The second flight was decidedly larger than the first.

Proxenus miranda (Grt.)

MUSEUM SPECIMENS EXAMINED: Forty-two males and 15 females from Cass County, Cass Lake, Crookston, Hallock, Houston County, Itasca Park, Olmsted County, Ramsey County, St. Paul; Dickinson County; Brookings; collected May 23 to September 19.

LIGHT TRAP COLLECTIONS: 1938-UF, 46♂, 2♀; 1938-MH, 126♂, 9♀; 1939-UF, 53♂, 22♀; 1939-MH, 79♂, 13♀; 1940-UF, 108♂, 26♀; 1940-MH, 36♂, 7♀. Total catches, 527 specimens; sex ratio, 3♂ to 1♀.

LUGGER COLLECTIONS: August 16.

SEASONAL HISTORY: Plate XV shows two generations a year with the first flight having occurred, for the most part, sometime during the last 10 days of May and June; the second flight took place mostly sometime during the last half of July, August, and the first part of September. The length of the summer gen-

eration was about 64 days. The 1939 flight appeared the earliest in the season, the 1938 flight slightly later, while that of 1940 was the most retarded. The sex ratio was about the same throughout the flights. The total numbers of individuals of both flights was about the same, although the second flight lasted longer.

Galgula partita Gn.

MUSEUM SPECIMENS EXAMINED: Forty males and five females from Cass County, Crookston, Hallock, Houston County, St. Paul; Dickinson County, Sioux City; Brookings; collected May 8 to September 14.

LIGHT TRAP COLLECTIONS: 1927-IL, 17 specimens; 1927-OL, 66 specimens; 1928-OL, 17 specimens; 1929-OL, 10 specimens; 1938-UF, 209 ♂, 10 ♀; 1938-MH, 577 ♂, 28 ♀; 1939-UF, 193 ♂, 6 ♀; 1939-MH, 215 ♂, 24 ♀; 1940-UF, 171 ♂, 47 ♀. Total catches, 1,592 specimens; sex ratio, 20.1 ♂ to 1 ♀.

LUGGER COLLECTIONS: (1).

SEASONAL HISTORY: Plate XVII shows that the seasonal history of this two-generation species is in many respects similar to that of *Caenurgina erechtea* (Cram.). The 1938 flights are very similar, both as to daily catches and as to the relatively few females taken during May and early June. The 1939 catches of May and June were also practically without females in both species, and the same general trend is shown throughout the year. In 1940, however, the first flight of *partita* Gn. appeared much later than *erechtea* (Cram.), although the second flight of each coincided. The flights of 1927 were also similar.

In 1927, the first flight occurred during the last part of May and the first part of June, and the second flight principally during the latter part of July and the first part of August. In 1928 and 1929 a few specimens of the second flight were taken in August, and one specimen of the first flight in June. In 1938 a large, prolonged first flight occurred principally during the last half of May and June, with a few catches in late April and early May due to a brief period of warm weather at that time. The second flight was mostly confined to the last three weeks of July and the first half of August; although it extended from early July to early September. In 1939 the first flight, in general, appeared slightly earlier in the season than that of 1938, while the second flight coincided with the corresponding flight of 1938. The first flight of 1940 was postponed by a relatively cool May, so that it covered June and early July and overlapped with the second flight which occurred mainly during the latter half of July and August.

The length of the summer generation was about 64 days in 1927, 52 days in 1938, and 60 days in 1939. In 1940 the interval between flights was about 41 days, but this probably does not represent the exact length of the summer generation, since the catches were undoubtedly postponed until the end of the cool and rainy May, although oviposition may have gone on during this month. The second flight, in general, was larger than the first. Although the seasonal appearance of the first flights varied greatly from year to year, that of the second flights coincided closely.

Balsa malana (Fitch)

MUSEUM SPECIMENS EXAMINED: Eighteen males and eight females from Olmsted County, St. Anthony Park, St. Paul; Sioux City; Brookings; collected May 23 to August 26, with four collections in May, two in June, seven in July, and four in August.

LIGHT TRAP COLLECTIONS: 1926-IL, August 1 to 11 (3); 1928-OL, July 22 to 25 (5); 1938-MH, May 20 to 30 (4 ♂), and August 3 to September 13 (4 ♂, ♀); 1939-UF, May 28 to June 1 (2 ♂, ♀), and July 14 to August 11 (6 ♂, 4 ♀); 1940-UF, May 20 to June 22 (5 ♂, 7 ♀); 1940-MH, July 21 to September 9 (6 ♂, 2 ♀). Total catches, 50 specimens; sex ratio, 1.4 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 19 and "July."

REARING DATA: St. Anthony Park, on apple July 5, 1920, pupated July 14, emerged August 6 (W. C. Cook); St. Paul, larva July 21, 1940 (P. Marvin), emerged August 8 (Herbert Knutson), ♀; St. Paul, pupa under codling moth band July 27, 1940 (P. Marvin), emerged August 5 (Herbert Knutson), ♂.

SEASONAL HISTORY: The light trap collections indicate two generations a year—the first flight totaling 18 specimens was taken from May 20 to June 22, and the second flight consisting of 32 individuals was taken July 14 to September 12. The great majority of the latter flight was captured during the last half of July and the first half of August. Larvae were collected July 5 and 21, the former pupating July 14 while another pupa was collected July 27; emergence dates of these pupae were August 5, 7, and 8, which show them to have been members of the summer generation.

Lugger *(20)* stated that he thought there were two generations, with the pupa the overwintering stage. Cook *(2)* recorded the first flight from May 21 to July 9, and the second from July 19 to September 2.

ECONOMIC IMPORTANCE: Lugger *(20)* reported injury in the

late autumn of 1897 by solitary larvae which were eating regular notches in the margins, and holes in the middle, of apple leaves. They seemed to prefer apple and shadberry, but also attacked cherry, plum, elm, poplar, and other trees.

Prodenia ornithogalli Gn.

The yellow-striped armyworm

MUSEUM SPECIMENS EXAMINED: Eleven males and five females from St. Anthony Park, St. Paul; Dickinson County, Sioux City; collected July 8 to October 31.

LIGHT TRAP COLLECTIONS: 1938-UF, August 1 to 28 (2 ♂, ♀); 1938-MH, July 22 to August 28 (5 ♂, ♀); 1939-UF, July 21 (♀), August 1 (♂); 1939-MH, August 4 (♂, ♀); 1940-UF, September 22 (♂); 1940-MH, August 8 to 16 (2 ♂).

LUGGER COLLECTIONS: September 19.

REARING DATA: Albert Lea, larvae collected September 3, pupa September 13, adult October 6 (W. C. Cook); Albert Lea, larva collected September 6 (nearly full grown), pupa September 13, adult October 6; Pipestone, August 13, 1934 (larva); Rochester, attacking soybeans, August 16, 1934.

SEASONAL HISTORY: The larvae collected were probably offspring from adults which flew up from the south, as it is generally believed that overwintering does not take place in the latitude of Minnesota. Thirty-two adult specimens were taken from July 8 to October 31, with the earlier collections from the more southern points.

Prodenia ornithogalli form *eudiopta* Gn.

MUSEUM SPECIMENS EXAMINED: Three males from Cass County, St. Paul; Sioux City; collected July 3 to September 10.

LIGHT TRAP COLLECTIONS: 1938-UF, August 28 (♂); 1938-MH, July 28 (♂); 1939-UF, September 4 to 12 (2 ♂); 1940-MH, August 4 (♂).

SEASONAL HISTORY: The collections of July 3 (Cass County), and July 8 (St. Paul), were well in advance of any made of typical *ornithogalli* Gn. in those latitudes.

Laphygma frugiperda (A. and S.)

The fall armyworm

MUSEUM SPECIMENS EXAMINED: Four males and two females from Olmsted County, St. Anthony Park; Dickinson County; collected July 5 to September 15.

LIGHT TRAP COLLECTIONS: 1927-IL, September 15 (2 ♀).

LUGGER COLLECTIONS: September 3 to 15 (2).

REARING DATA AND REPORTS OF DAMAGE: St. Paul (Daytons Bluff), larvae on purslane and reared on clover, pupa October 9, two emerged November 19 and one November 20; Ramsey County, larvae on corn leaves September 9, nearly full grown.

SEASONAL HISTORY: This species is generally believed to be unable to overwinter in the latitude of Minnesota. The earliest adult collection in northern Iowa was July 5, while the earliest in the St. Paul area was August 22. The larvae undoubtedly represent offspring from moths which flew up from the south.

ECONOMIC IMPORTANCE: Lugger *(20)* found the larvae and eggs repeatedly on apple, although he believed there was little danger of destruction to orchards.

In the northern states greatest damage is done to corn, in which it resembles the corn earworm. Young winter wheat is also frequently attacked, and numerous other plants are attacked to a lesser extent. The marching habit is occasionally assumed.

Cosmia canescens (Behr.)

MUSEUM SPECIMENS EXAMINED: Sixty males and 43 females from Olmsted County, St. Paul, Washington County; collected July 12 to August 2.

LIGHT TRAP COLLECTIONS: 1927-IL, 41 specimens; 1927-OL, 130 specimens; 1928-OL, 281 specimens; 1929-OL, 393 specimens; 1938-UF, 3 ♂, ♀; 1938-MH, 6 ♂, ♀; 1939-UF, ♂, 7 ♀; 1939-MH, 3 ♀; 1940-UF, 24 ♂, 5 ♀; 1940-MH, ♂, 6 ♀. Total catches, 903 specimens; sex ratio, 1.5 ♂ to 1 ♀.

SEASONAL HISTORY: Plate XVII indicates a one-generation species, with all catches sometime between July 1 and August 9. The peak of all years was July 13. The flights appeared progressively earlier in the season each year through 1939, and the 1940 flight was again delayed in appearance. The 1929 flight took place about 12 days earlier in the season than that of 1927.

Ogdoconta cinereola (Gn.)

MUSEUM SPECIMENS EXAMINED: Seventeen males and 12 females from Hennepin County, Houston County, Mankato, Olmsted County, Ramsey County, St. Paul; Dickinson County, Sioux City; Brookings; collected May 23 to August 15.

LIGHT TRAP COLLECTIONS: 1928-OL, 5 specimens; 1938-UF, 15 ♂, 8 ♀; 1938-MH, 19 ♂, 7 ♀; 1939-UF, 21 ♂, 3 ♀; 1939-MH, 3 ♂, 5 ♀; 1940-UF, 12 ♂, 4 ♀; 1940-MH, 3 ♂, 4 ♀. Total catches, 109 specimens; sex ratio, 2.4 ♂ to 1 ♀.

LUGGER COLLECTIONS: July 9 to August 20 (4).

SEASONAL HISTORY: Plate XVI shows a two-generation species. The first flight covered approximately June and early July, while the second covered mostly late July and August; the maximum catches of the latter flight were during the last week in July and the first two weeks in August. The second flight was much larger than the first.

Psychomorpha epimenis (Dru.)

MUSEUM SPECIMENS EXAMINED: Hennepin County (Nine Mile Creek), April 30, 1938 (A. W. Buzicky), ♂; Washington County, May 11, 1940 (D. M. Benjamin), ♂.

SEASONAL HISTORY: This species is very common in the south in the early spring. The above collections of apparently newly emerged individuals indicate the probability that they successfully overwintered in the state.

SUBFAMILY HELIOTHIINAE

Heliothis armigera (Hbn.)

The corn earworm [=*obsoleta* (Fabr.)]

MUSEUM SPECIMENS EXAMINED: Twenty-two males and 11 females from St. Paul, Yellow Medicine County; Dickinson County; Brookings; collected as follows—August 1 (St. Paul, at light), August 7 (Brookings), August 14 (Dickinson County), August 19 (Dickinson County), and 29 from September 8 to November 5.

LIGHT TRAP COLLECTIONS: 1926-IL, August 15 to September 17 (9); 1927-OL, September 16 (3); 1938-UF, September 10 to 11 (10 ♂, 2 ♀); 1938-MH, August 5 to September 15 (17 ♂, 3 ♀); 1939-UF, September 2 to 15 (3 ♂, 4 ♀); 1939-MH, August 30 to September 8 (♂, ♀); 1940-UF, September 18 to October 5 (8 ♂, 7 ♀). Total catches, 68 specimens; sex ratio, 38 ♂ to 18 ♀.

LUGGER COLLECTIONS: October 1.

REPORTS OF DAMAGE: St. Paul, larvae half to full grown, September 19, 1930; Marshall, corn, September 17, 1932; St. Paul, corn, September 17, 1932; Kellogg, corn, September 28, 1932. New Ulm, ground cherry, September 17, 1933; Minneapolis, in loaf of bread, October 11, 1933.

In 1934, Blue Earth, 50 acres of corn, working on parts other than ear, nearly full grown June 29; Fairmont, tassels of corn, July 2; Le Sueur, tassels of corn, July 2; Mankato, tassels of corn, July 2; Shakopee, tassels of corn, July 2; Freeborn County, July

3; Janesville, corn, July 5; Lewisville, corn, July 5; Waldorf, corn, July 5; Windom, corn, July 5; Sleepy Eye, July 7; Adrian, corn, July 10; Cottonwood County, corn, July 10; Excelsior, July 10; Cokato, corn, July 16; Minneiska, corn, July 16; Park Rapids, corn, July 16; Wadena, corn, July 16; Fergus Falls, popcorn, July 18; Renville, corn, July 21; Richfield, tomatoes, July 21; Spring Grove, corn, July 24; Benson, corn, August 6; Minneapolis, corn, August 13; Twin Valley, corn, August 29; Prior Lake, September 4; Plummer, popcorn, September 7, larvae averaging about half grown.

Hennepin County, corn, July 18 [probably 1935], larvae half grown; Lewiston, sweet corn, August 1, 1935; Plainview, corn, August 6, 1935.

REARING DATA: Osseo, larvae abundant on sweet corn, pupated October 5; St. Paul, emerged July 19, 1934 (C. E. Hoffman), [adult very small].

SEASONAL HISTORY: In 1934, an outbreak year, reports came in unusually early. During that year the first report came in from Blue Earth on June 29, these larvae being mostly full grown when reported. The specimen reared July 19 probably developed about the same time. Numerous reports followed from June 29 to July 24, indicating larvae which developed from eggs laid sometime during June and early July. The sudden discontinuation of reports after July 24 may have indicated final pupation of this group of larvae since the corn was still suitable for attack at that time. On the other hand, this drop-off in reports after July 24 may have been due to the oncoming field corn which was available for oviposition during the first part of July; thus infestation would be dispersed and consequential damage less noticeable. The few larval collections during August and September of 1934 coincide in appearance with reports of minor damage which occur yearly just before the harvesting of field corn. These later 1934 collections undoubtedly represent a different group of larvae from that collected in June and July; they may have represented offspring of the early season group, or offspring of moths which flew up from the south, or both.

Numerous complaints occur yearly during late August, September, and early October. Many of these larvae attain the pupal stage before winter sets in, while others perish while still in the larval stage. It is probable that the above light trap collections represent both adults which produce these larvae and pupae which are reported late in the season, and moths which have recently flown up from farther south. Third to fifth instar larvae

have been collected near St. Paul on sweet corn as early as July 15 in 1938, which would show that moths were present at least as soon as early July. This was 21 days before any were taken at lights during that year. Thus the light traps failed to catch moths while they were ovipositing or for some time after they are known to have been present; this supposition is further supported, as all females taken at lights were spent.

Whether pupae can survive the winter in Minnesota has been the subject of much discussion. Lugger *(19)* thought that they were unable to survive the winter, and concluded that they must fly up each year from the south. The winter of 1933-1934 was relatively dry and warm, both factors having been found to be favorable for pupal survival; yet no conclusions can be drawn in this respect because the spring of 1934 was accompanied by abnormally steady south winds which would be favorable for blowing adults up from the south.

Because infestation is confined to late in the season during ordinary winters, it appears probable that moths come in from the south and lay the eggs which produce late season injury. It is possible that, during mild and favorable winters like 1933-1934, some pupae may survive locally and emerge in time to produce early larvae as reported in 1934.

ECONOMIC IMPORTANCE: In 1934, earliest reports involved corn tassels, while late reports were concerned with the ears. Most damage occurs when the ear is in silk, when burrows pave the way for pathogens and occasionally prevent pollination. Much damage is also done to the kernels, and the resulting white powder is irritating to the eyes of the husker. Sweet corn, an important crop in the state, is practically unmarketable with only one larva present. Ground cherries, tomatoes, beans, peppers, and other vegetables are also attacked.

Lugger *(19)* reported many complaints during the latter part of the summer of 1895. Washburn *(29)* reported a 50 per cent infestation of corn during 1905. Ruggles *(26)* recorded severe damage during 1921, although it had usually been 5 per cent or less during the seven previous years; in 1920, field corn suffered heavily with an estimated 20 per cent infestation, while in 1922 the infestation was only slightly higher than normal.

Schinia arcigera (Gn.)

MUSEUM SPECIMENS EXAMINED: Four males and eight females from Olmsted County, St. Paul; Dickinson County; Brookings; collected July 24 to August 19.

LIGHT TRAP COLLECTIONS: 1927-OL, 15 specimens; 1928-OL, 46 specimens; 1929-OL, 39 specimens; 1938-UF, 2 ♂; 1938-MH, 15 ♂; 1939-UF, 2 ♂, 3 ♀; 1939-MH, 2 ♂; 1940-UF, 2 ♂, ♀; 1940-MH, 3 ♂, 2 ♀. Total catches, 132 specimens; sex ratio, 26 ♂ to 6 ♀.

SEASONAL HISTORY: Plate XVI shows one generation a year with flights mostly confined to sometime within the last half of July and the first three weeks of August. The 1928 flight appeared earlier in the season than that of 1929, while the remaining flights appear to have coincided with that of the latter year.

SUBFAMILY ACONTIINAE

Erastria carneola Gn.

MUSEUM SPECIMENS EXAMINED: Seventy-five males and 28 females from Arco, Cass Lake, Chisago County, Crookston, Hallock, Hennepin County, Houston County, Itasca Park, Lake City, Luverne, Marshall County, Olmsted County, Rock County, St. Anthony Park, St. Paul, Wilkin County; Dickinson County, Sioux City; Brookings; Fargo, North Dakota; collected May 5 to September 24.

LIGHT TRAP COLLECTIONS: 1927-IL, 196 specimens; 1927-OL, 553 specimens; 1928-OL, 328 specimens; 1929-OL, 409 specimens; 1938-UF, 286 ♂, 62 ♀; 1938-MH, 170 ♂, 81 ♀; 1939-UF, 362 ♂, 136 ♀; 1939-MH, 205 ♂, 115 ♀; 1940-UF, 147 ♂, 45 ♀; 1940-MH, 20 ♂, 13 ♀. Total catches, 3,128 specimens; sex ratio, 2.4 ♂ to 1 ♀.

SEASONAL HISTORY: Plate XVIII shows two generations a year, with the first flight uniformly much smaller than the second. The length of the summer generation was about 48 days in 1927, 55 days in 1929, 62 days in 1938, 47 days in 1939, and 56 days in 1940. The flights appeared progressively earlier in the season from 1927 through 1939, while the 1940 flight was again retarded in appearance. A combination of a short summer generation, a great variation of the seasonal appearance of the flights, and the uniformly smaller first flight produced a "total of all years" which fails to show the general flight peaks. An analysis of the individual yearly flights, however, shows that the first flight occurred sometime during the last part of May, June, or early July, and the second flight sometime during July, August, or early September. The seasonal appearance varied as much as 19 days from year to year. The sex ratio was about the same throughout the flights.

Egg dissections revealed that oviposition was first apparent in 1938 during the first week in June and had nearly finished by the

end of that month. The second flight of 1938 first showed laying during the last nine days of July, and it continued on through the first week in August, with a few gravid females still present later in the season. In 1940, the second flight appeared slightly later in the season, and oviposition occurred correspondingly later.

Cook *(2)* collected 1,996 specimens at bait, but stated that the "broods" were not well marked.

Neoerastria apicosa (Haw.)

MUSEUM SPECIMENS EXAMINED: Four males and four females from Olmsted County, St. Anthony Park, St. Paul; Sioux City; collected July 27 to September 6.

LIGHT TRAP COLLECTIONS: 1927-IL, 2 specimens; 1927-OL, 4 specimens; 1928-OL, 5 specimens; 1929-OL, 8 specimens; 1938-UF, 4 ♂, 3 ♀; 1938-MH, 3 ♂, 2 ♀; 1939-UF, 6 ♀; 1939-MH, 9 ♂, 5 ♀; 1940-UF, 3 ♂, 4 ♀; 1940-MH, 4 ♂, ♀. Total catches, 57 specimens; sex ratio, 23 ♂ to 21 ♀.

LUGGER COLLECTIONS: June 26 to "all of September" (5).

SEASONAL HISTORY: Plate XVI probably represents two generations a year, with a seasonal history similar to that of *E. carneola* Gn. The flights appeared progressively earlier in the season each year through 1939, and the 1940 flight was again delayed.

Chamyris cerintha (Treit.)

MUSEUM SPECIMENS EXAMINED: Twelve males and 20 females from Olmsted County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; collected June 22 to July 17.

LIGHT TRAP COLLECTIONS: 1938-UF, June 27 to July 14 (3 ♂); 1938-MH, June 26 (♂), July 8 (♂); 1939-UF, June 5 to July 11 (3 ♂, 2 ♀); 1940-UF, July 9 to 31 (2 ♂, 2 ♀); 1940-MH, June 29 (♀).

LUGGER COLLECTIONS: "June" and July 13.

SEASONAL HISTORY: One generation a year is shown by 47 collections from June 5 to July 31. The great majority was made during late June and early July.

ECONOMIC IMPORTANCE: Lugger *(20)* states that it feeds on apple, plum, rose, and related plants, but that it was not common enough to cause much injury.

Tarachidia candefacta (Hbn.)

MUSEUM SPECIMENS EXAMINED: Thirty-three males and 18 females from Cass County, Cass Lake, Crookston, Douglas County, Faribault, Fillmore County, Florian, Houston County, Lake

Johanna, Ramsey County, Red Lake Falls, Rock County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected May 23 to August 22.

LIGHT TRAP COLLECTIONS: 1927-IL, 2 specimens; 1927-OL, 3 specimens; 1928-OL, 1 specimen; 1938-UF, 129 ♂, 37 ♀; 1938-MH, 210 ♂, 64 ♀; 1939-UF, 75 ♂, 17 ♀; 1939-MH, 58 ♂, 8 ♀; 1940-UF, 37 ♂, 20 ♀; 1940-MH, 16 ♂. Total catches, 677 specimens; sex ratio, 3.6 ♂ to 1 ♀.

SEASONAL HISTORY: Egg dissections showed that oviposition in the captured females first took place during the third week of June in 1938, with the maximum during the last week of June. Laying continued on through the flight season. The last two weeks in July were characterized by fewer females, while there was an increase in gravid females during the first three weeks of August; this indicates two generations a year. A high percentage of gravidity was evident throughout the flights.

Plate XIX shows that this species was taken, during the latter three years of larger catches, more or less continuously from the latter part of May until the first part of September. In 1938 the first catches were made May 28, and these were almost immediately followed by a peak. A reduction in numbers occurred during the second week in June, and this was followed by another peak during the last half of June; thereafter, the numbers became progressively less through July, and remained about constant through August. The 1938 flights of *G. partita* Gn. and *C. erechtea* (Cram.) resemble those of this species. In 1939 the first catches were made May 20, and they continued without pronounced peaks until the end of the flight on September 6; it is possible that three flights may have taken place during this year. In 1940 the flights extended from June 1 to September 6, and concentrations were apparent during the middle of June and again during late July and early August, which indicates two generations.

SUBFAMILY PLUSIINAE

Autographa falcifera (Kby.)

The celery looper

MUSEUM SPECIMENS EXAMINED: Fifty-five males and 13 females from Altura, Cass County, Cass Lake, Cokato, Crookston, Itasca Park, Minnetonka Lake, Olmsted County, Pipestone County, Sleepy Eye, St. Anthony Park, St. Paul, Two Harbors; Sioux City; Brookings; collected May 2 to September 10.

LIGHT TRAP COLLECTIONS: 1927-IL, 50 specimens; 1927-OL, 228 specimens; 1928-OL, 106 specimens; 1929-OL, 403 specimens; 1938-UF, 270 ♂, 12 ♀; 1938-MH, 588 ♂, 16 ♀; 1939-UF, 494 ♂, 13 ♀; 1939-MH, 385 ♂, 16 ♀; 1940-UF, 454 ♂, 6 ♀; 1940-MH, 391 ♂, 6 ♀. Total catches, 3,438 specimens; sex ratio, 37.8 ♂ to 1 ♀.

LUGGER COLLECTIONS: "June," and August 26 to September 19 (3).

REARING DATA: St. Anthony Park, larvae on leaves of celery June 30, 1919, left celery for cabbage in cage, a few still feeding July 5, all "disappeared" by July 6, pupa July 10 (W. C. Cook).

SEASONAL HISTORY: From Plate XX the following interpretations are advanced: In 1927, a very small first flight during late May and early June was followed closely by a second flight in late June and in July. In 1928, a possible first flight of three moths in late May was followed by a second flight during late June and in July. The first flight of 1929 attained a peak during the last week in May, and this was followed by a second flight in late June and in July. In 1938, the first flight extended from late April through the first week in June, and the second during the latter half of June, July, and the first week in August. The first flight of 1939 extended through the last three weeks of May and the first part of June, while the second covered the latter half of June, July, and the first week in August. In 1940, a possible first flight was mainly confined to June, and a second flight mainly to July and early August. In some instances the flights overlapped and there were many stragglers; because of this, the "total of all years" is not very representative for any single year, although a peak is shown during late May and again during the second week of July.

The first flights appeared progressively earlier in the season each year through 1938, while the 1939 and 1940 flights were progressively more delayed. The second flights, however, appeared progressively earlier in the season in the following order—1928, 1940, 1929 and 1938 (about identical), 1927, and 1939. The second flight peaks assumed the same sequence, as to seasonal appearance, as shown in many other species, except that the 1927 and 1929 flights came relatively early.

The data indicate two generations with flights which overlap during certain years. This, along with the enormous range of collection dates for the second flight, indicates a loose seasonal history rhythm. This is one of the earliest-appearing multiple-generation species, and it is probable that the fore part of the first flight is not well represented at lights.

Forbes *(14)*, at Ithaca, New York, found one well-marked "brood" in May and stragglers later. Dirks *(11)*, at Orono, Maine, found two overlapping "broods." He reported, "The first brood was abundant either at the end of June or early in July. The entire period of flight for this early generation extended from May until the middle of July. The second brood of moths became active during late July and continued on the wing through August and September. The individuals of the second brood were generally most abundant the first half of August." The findings of both of these workers vary widely from that described above.

ECONOMIC IMPORTANCE: Despite the large amount of celery grown in the state, complaints of this very common species are rare. It has also been reported as attacking lettuce, sugar beets, and many other crops.

Autographa brassicae (Riley)

The cabbage looper

MUSEUM SPECIMENS EXAMINED: Twenty males and 56 females from Crookston, Olmsted County, Plummer, Sleepy Eye, St. Anthony Park, St. Paul, Wilkin County; Dickinson County, Sioux City; Brookings; one collected May 23, and the remainder June 9 to October 1.

LIGHT TRAP COLLECTIONS: 1927-IL, 19 specimens; 1927-OL, 44 specimens; 1928-OL, 1 specimen; 1929-OL, 11 specimens; 1938-UF, 13 ♂, 13 ♀; 1938-MH, 6 ♂, 5 ♀; 1939-UF, 15 ♂, 7 ♀; 1939-MH, 9 ♂, 8 ♀; 1940-UF, 15 ♂, 12 ♀; 1940-MH, 6 ♂, 14 ♀. Total catches, 198 specimens; sex ratio, 1.1 ♂ to 1 ♀.

REARING DATA: University Farm, larvae on tomatoes August 3, 1931, all pupated by August 6, three adults August 8, 18 adults August 10, one adult August 12; University Farm, pupa attached to rug in house July 29, 1940, emerged July 29 (Herbert Knutson), ♂.

REPORTS OF DAMAGE: Lewiston, on tomatoes and cabbage August 1, 1935; Forest Lake, August 23, 1935; Marshall, on cabbage August 24, 1935. Breckenridge, pupae found on ash trees August 24, 1936.

SEASONAL HISTORY: Only four of the 39 females dissected were spent. Laying was first evident during the third week in July in 1938, and the last week in July in 1940.

Plate XIX shows light trap catches which are difficult to interpret. It appears most probable that there are two flights, a first small flight having occurred in late June or July, and a much larger second flight sometime during late July, August, and early

September. Larval reports ranged from August 1 to 24, pupal records ranged from July 29 to August 24, and extreme emergence dates were July 29 and September 5; these specimens were probably late members of the summer generation.

The flights appeared progressively earlier in the season each successive year through 1939 (in 1928 only one specimen was captured), while the 1940 flight was again delayed in appearance. The sex ratio was about the same throughout each flight.

ECONOMIC IMPORTANCE: A few August reports of damage to tomatoes and cabbage are recorded; many other garden crops are also attacked. The outer leaves of cabbage are attacked in the same manner as by the imported cabbage worm, and doubtless some of the damage attributed to the latter may be due to *brassicae* (Riley).

Autographa contexta (Grt.)

MUSEUM SPECIMENS EXAMINED: Three males and four females from Anoka County, Crookston, St. Paul; Dickinson County; collected May 21 to August 13.

LIGHT TRAP COLLECTIONS: 1927-IL, 2 specimens; 1927-OL, 8 specimens; 1928-OL, 2 specimens; 1929-OL, 2 specimens; 1938-MH, 13 ♂, 6 ♀; 1939-UF, 2 ♂, 2 ♀; 1939-MH, 17 ♂, 11 ♀; 1940-MH, 3 ♂, 2 ♀. Total catches, 70 specimens; sex ratio, 35 ♂ to 21 ♀.

SEASONAL HISTORY: Collections were made from May 20 to September 15, with no apparent peaks, as shown by Plate XIX. Because of the long period of collections, it is apparent that this is a multiple-generation species.

Dirks *(11)*, at Orono, Maine, found the first "brood" late in June and the first half of July, and the second during the first half of August.

Autographa precationis (Gn.)

MUSEUM SPECIMENS EXAMINED: Twenty-three males and 12 females from Altura, Crookston, Marshall, Olmsted County, Ramsey County, St. Anthony Park, St. Paul; Dickinson County, Sioux City; Brookings; collected May 5 to October 3.

LIGHT TRAP COLLECTIONS: 1927-OL, 14 specimens; 1928-OL, 1 specimen; 1929-OL, 21 specimens; 1938-UF, 3 ♂; 1938-MH, 11 ♂; 1939-UF, 9 ♂, 2 ♀; 1939-MH, 23 ♂, 12 ♀; 1940-UF, 9 ♂, ♀; 1940-MH, 12 ♂, 2 ♀. Total catches, 120 specimens; sex ratio, 3.8 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 16.

SEASONAL HISTORY: The "total of all years" of Plate XXII shows three feeble peaks—the first during the latter half of May

and the first half of June, the second during the last 26 days of July, and the third during the latter half of August and the first part of September. Only the 1939 flight, however, shows this same trend, the yearly catches of the remaining years being too small and scattered to show any, or more than one, peak during a single year. The wide range of collections indicate a multiple-generation species, and it is probable that three generations occurred in 1939.

Abrostola urentis Gn.

MUSEUM SPECIMENS EXAMINED: Eight males and four females from Olmsted County, Stillwater; Dickinson County; Brookings; collected June 7 to August 7.

LIGHT TRAP COLLECTIONS: 1927-IL, 2 specimens; 1927-OL, 3 specimens; 1928-OL, 10 specimens; 1938-UF, 4 ♂, ♀; 1939-UF, 15 ♂, 3 ♀; 1939-MH, ♂, 3 ♀; 1940-UF, ♀; 1940-MH, 3 ♂, 2 ♀. Total catches, 48 specimens; sex ratio, 23 ♂ to 10 ♀.

SEASONAL HISTORY: Plate XIX apparently indicates two generations a year, with a reduction of catches about the middle of July. Further evidence of a multiple-generation species is shown by the extended collections of 1938, which were made from late May until the third week in August.

SUBFAMILY CATOCALINAE

Caenurgina erechtea (Cram.)

The forage looper

MUSEUM SPECIMENS EXAMINED: Fifty males and 48 females from Becker County, Big Stone County, Cass County, Cass Lake, Crookston, Hennepin County, Itasca Park, Luverne, Olmsted County, St. Anthony Park, St. Paul, Two Harbors; Dickinson County, Sioux City; collected May 9 to September 22.

LIGHT TRAP COLLECTIONS: 1927-IL, 95 specimens; 1927-OL, 322 specimens; 1928-OL, 590 specimens; 1929-OL, 1,077 specimens; 1938-UF, 246 ♂, 38 ♀; 1938-MH, 670 ♂, 59 ♀; 1939-UF, 379 ♂, 32 ♀; 1939-MH, 223 ♂, 42 ♀; 1940-UF, 314 ♂, 27 ♀; 1940-MH, 90 ♂, 13 ♀. Total catches, 4,217 specimens; sex ratio, 9.1 ♂ to 1 ♀.

LUGGER COLLECTIONS: May 3 to September 1 (4).

SEASONAL HISTORY: Plate XXI shows two generations a year, although the two flights are not well defined in some years. In 1927, the first flight peak was reached during the third week in May and the second flight occurred mainly in late July and

August. In 1928, only two specimens of the first flight were taken, but a large second flight is shown during the last three weeks in July and August, with the peak during the last half of July. The first flight of 1929 extended from May 13 through the first three weeks of June, with the peak during the last week in May; the second flight started about the first of July, gradually increased to a peak during the last of July and the first part of August, and then gradually decreased through August. The first individuals of 1938 appeared during a brief warm spell in late April and early May, which was followed by a period of unfavorable weather that prevented flight again until the middle of May. After this the numbers increased at the Midland Hills light trap to a maximum on May 29, which was in turn followed by almost a cessation of catches during the second week in June. A sudden increase occurred at the beginning of the third week in June, which was followed by a gradual reduction throughout the remainder of that month.

The second flight of 1938 was marked by an increase in numbers during the first part of July; then they gradually decreased throughout the remainder of July and August. The first flight of 1939 occurred principally in May, with the low ebb during the second week in June. The second flight began to appear during the third week in June and continued to a peak during the second and third weeks in July, whereupon they fell off gradually throughout the remainder of July, August, and the first part of September. In 1940, the first flight started during the second week in May, reached a peak during the last half of May and the first week in June, and then gradually declined to a low ebb during late June and early July. The second flight of 1940 began to mount during the second week in July, with the greatest numbers taken during the last two weeks in July and the first two weeks in August; then the catches gradually declined through the remainder of August and September.

In 1938, only one female was taken at light until the second week in June, although large numbers of males were taken at that time and on throughout the season. All of the relatively large number of females taken during the last half of June were beyond the preoviposition stage, which indicates that they were present along with the males earlier in the season, but were not attracted to lights at that time. The first part of the second flight of 1938 (during the first two or three weeks of July) was characterized by a slightly smaller percentage of females, and all females taken later in the flight (when the greater percentage of females oc-

curred) were past the preoviposition stage. Only two females of the first flight of 1940 were taken, although numerous females were taken and were about equally distributed throughout the second flight; the early females of the second flight were in the preoviposition stage, and the number of eggs decreased as the flight progressed. The first flight of 1939 is similarly shown to have had a much higher percentage of males than the second. The first flight was in every case composed of smaller individuals (dwarfs) than those of the second.

With the exception of 1928 in which practically no specimens of the first flight were taken, the first flights appeared increasingly earlier in the season each year through 1938, while the catches of 1939 and 1940 were progressively later than in 1938 [similar to *A. falcifera* (Kby.)]. A comparison of the second flight peaks, however, appears to offer more reliable data as to seasonal appearance. The peak of female catches and the preoviposition period for 1938 actually occurred during the last week in July, which was later in the season than the corresponding flight in 1939; thus the first flight of 1938 was accelerated because of the abnormally warm weather in late April and early May, which resulted in the abnormally early flight of some of the more developed members of the first flight. Therefore the peak during the last week in May is more nearly representative of the general first flight of 1938, and actually places its general appearance later in the season than that of 1939. It is apparent that the same situation prevailed as did in the case of most other two-generation species, *i.e.,* the flights appeared progressively earlier in the season each year through 1939, and the 1940 flights were again delayed.

The seasonal history of this species appears to coincide with that of the closely related *crassiuscula* (Haw.). Although the latter was much less abundant at lights (92 to 4,217), the total number of museum specimens examined was more than *erechtea* (Cram.), and the hand collections outnumbered it two to one.

Dean and Smith *(8)* stated that it overwinters in Kansas mainly as a pupa, and that there are three complete generations and a partial fourth.

Alabama argillacea (Hbn.)

The cotton leafworm

MUSEUM SPECIMENS EXAMINED: Thirteen males and nine females from Altura, Crookston, Olmsted County, St. Paul; Sioux City; Brookings; collected September 3 to October 22. Also seven

specimens from Eden Prairie, September 26, 1930, "damaging strawberry" (A. G. Ruggles).

LIGHT TRAP COLLECTIONS: 1926-IL, September 2 to 10 (5); 1927-IL, September 15 to 16 (3); 1927-OL, September 15 to 16 (4); 1929-OL, August 31; 1938-UF, September 10 to 11 (♂, ♀); 1938-MH, September 6 to 12 (4 ♂).

SEASONAL HISTORY: It is generally believed that this species is unable to survive the winter in the latitude of Minnesota, and that the adults fly up from the south. The earliest collection was August 31.

ECONOMIC IMPORTANCE: The adults pierce the everbearing strawberry fruit with their mouthparts. Severe damage was caused in September of 1930 and 1941. They may also puncture grapes in the same manner.

SUBFAMILY HYPENINAE

Plathypena scabra (Fabr.)

The green clover worm

MUSEUM SPECIMENS EXAMINED: Sixty-five males and 50 females from Appleton, Beltrami County, Cass County, Cook County, Crookston, Grand Rapids, Hallock, Lake Elmo, Luverne, Olmsted County, St. Anthony Park, St. Paul, Wilkin County; Dickinson County; Brookings; collected July 5 to September 18.

LIGHT TRAP COLLECTIONS: 1928-OL, 1 specimen; 1938-UF, 10 ♂, 9 ♀; 1938-MH, 129 ♂, 102 ♀; 1939-UF, ♂, 2 ♀; 1939-MH, 27 ♂, 19 ♀; 1940-UF, 6 ♂, 4 ♀; 1940-MH, 14 ♂, 11 ♀. Total catches, 335 specimens; sex ratio, 1.3 ♂ to 1 ♀.

SEASONAL HISTORY: Plate XXII shows a first flight which occurred in May, and a second which took place mainly sometime during late June, July, and August. The great majority of the latter flight was taken in July. This latter flight was always much larger, and no specimens of the first flight were taken when the total yearly catch was small. Two generations a year are indicated.

Practically all the females of the first flight of 1938 were highly gravid, and a high percentage of the second were likewise, as only six of 116 females were spent.

ECONOMIC IMPORTANCE: About one acre of alfalfa was slightly damaged near St. Paul in 1938. While larvae are occasionally abundant, they are seldom noticed.

SUBFAMILY HERMINIINAE

Camptylochila americalis (Gn.)

MUSEUM SPECIMENS EXAMINED: Twenty-two males and 24 females from Cass County, Cass Lake, Chisago County, Cook County, Crookston, Hennepin County, Itasca Park, Olmsted County, St. Anthony Park, St. Paul; Dickinson County; collected as follows—first group, June 5, 11, 26, 30, "June," and 28 specimens in July; second group, 10 specimens taken August 7 to September 15.

LIGHT TRAP COLLECTIONS: 1927-IL, 2 specimens; 1927-OL, 8 specimens; 1928-OL, 12 specimens; 1929-OL, 14 specimens; 1938-MH, 3 ♂; 1939-MH, 3 ♂, ♀; 1940-UF, 5 ♂, 2 ♀. Total catches, 50 specimens.

LUGGER COLLECTIONS: June 16 to August 16 (4).

SEASONAL HISTORY: Plate XXII shows a first flight which occurred mainly in late June and July, and a second flight of smaller size which took place mostly during the last three weeks in August and the first part of September. The museum specimens also indicate two generations a year. The flights approximate those of *C. aemula* (Hbn.), with the first flight of both species being larger than the second.

Camptylochila aemula (Hbn.)

MUSEUM SPECIMENS EXAMINED: Twenty-nine males and 25 females from Cass County, Chisago County, Friesland, Hennepin County, Le Sueur County, Olmstead County, Ramsey County, St. Anthony Park, St. Paul; Sioux City; collected June 19 to August 30. Also, 22 specimens from St. Paul, "reared from dry oak leaves, spring of 1927" (C. T. Schmidt).

LIGHT TRAP COLLECTIONS: 1927-IL and 1927-OL, 157 specimens; 1928-OL, 72 specimens; 1929-OL, 52 specimens; 1938-UF, 30 ♂, 23 ♀; 1938-MH, 2 ♂, 4 ♀; 1939-UF, 2 ♂; 1939-MH, 3 ♂, ♀; 1940-UF, 15 ♂, 22 ♀; 1940-MH, 2 ♂, 2 ♀. Total catches, 387 specimens; sex ratio, 1 ♂ to 1 ♀.

LUGGER COLLECTIONS: June 19 to August 2 (5).

SEASONAL HISTORY: Two generations a year are shown by plate XXII. In the "total of all years," the first flights are shown to have taken place mainly during July and early August, with the peak during the latter part of July. The second flights occurred during late August and the first part of September. In 1927, the first flight peak was very pronounced, while the second was much

smaller. In 1928, almost every specimen taken belonged to the first flight. The first flight of 1929 was very small, but the second attained a brief but rather pronounced peak. In 1938, the first flight was quite evident, but the second was represented by one male and one female. In 1939, only two males of the second flight were taken. The flights of 1940 were retarded in appearance, the first coming mainly in early August and the second during the first half of September. The short interval between flights suggests a short summer generation characteristic of some of the smaller species.

Forbes *(14)*, at Ithaca, New York, found a heavy "brood" in July and a partial second in September.

General Consideration of Seasonal History

In the above discussions, the number of generations of 232 species has been established. Of these, 175 are one-generation species, while 57 are multiple-generation species; this is a ratio of about three to one. This ratio is probably not representative for the family as a whole, however, since the one-generation condition is more readily recognized when the collections are small. It appears more probable that about one third are multiple-generation species.

The remaining discussion is necessarily limited to those species which were taken in sufficient numbers for analysis. It is probable, however, that it applies in a general way to most of the family as a whole, since these species with larger catches were generally distributed throughout the family.

Each stage of the life cycle requires a definite minimum period of time, and the temperature is the primary factor in rate of development. Therefore, it is possible to calculate, in a general way, the time of occurrence of at least some of the other stages when the appearance of the adult stage is known. These calculations are, in nearly all cases, omitted from the discussions above, and are described below for general application whenever possible.

MULTIPLE-GENERATION SPECIES

These studies have indicated that all multiple-generation species in Minnesota normally have two generations a year owing to the relatively short length of the growing season. A few, such as *A. precationis* (Gn.), *L. unipuncta* (Haw.), and *T. candefacta* (Hbn.), may have three generations during abnormally long

growing seasons. In Tennessee and southward, two, three, four, or more generations a year are found. Two or three generations are most common in the latitude of Illinois, Missouri, and Kansas. In Maine the most common condition is two generations, with some exceptions discussed below. In all areas partial generations are not uncommon.

While most multiple-generation species probably have two generations at their northern range limit, several notable exceptions are to be found in the work of Dirks *(11)*. In his Maine studies, *L. renigera* (Steph.), *L. luteopallens* Sm., *G. c-nigrum* (L.) [probably], *O. plecta* (L.), *L. phragmatidicola* Gn., and *P. atlantica* (Grt.) were found to have but one flight (which was prolonged in some instances), although they normally have two flights in the St. Paul, Minnesota, area. At least most of these are among the few multiple-generation species which have their metropolis in the north, and four of them occur commonly in Europe. This modification toward one flight per season shows an ability to adapt to a shorter and colder growing season. Further evidence of this adaptation is shown by the Minnesota flights of *L. renigera* (Steph.) and *L. luteopallens* Sm., which were taken in sufficient numbers for detailed comparison of flights throughout the six years of trap operations. In 1927, 1928, and 1929, the flights were greatly modified from the usual two flight condition as described in the discussion of *renigera* (Steph.). This modification was apparently due to the abnormally low temperatures during the first part of the 1927 season and somewhat below normal temperatures during the spring of 1928. The 1929 catches also exhibited the same characters, although temperatures were more nearly normal. Unfortunately the four remaining species listed above were not taken in sufficient numbers in order to determine whether or not they too showed this same trend. However, no such flight modifications during these three years were found in any of the multiple-generation species with their metropolis in the south. Apparently the flights of these three abnormal years in Minnesota approached conditions found by Dirks in Maine, since the peak of the Maine flight coincided rather closely with the largest middle peak in Minnesota. Plate VII shows that at least a second partial flight may have occurred very late in the growing season, although it is questionable how many of the offspring survived the winter in such a retarded stage. In the case of *G. c-nigrum* (L.) and *O. plecta* (L.), Dirks stated that the flights were extended and that there was a possibility of a partial second brood in the case of the former. It therefore

appears that these few multiple-generation species with their metropolis in the north enjoy a range farther northward by an approach to a one-generation condition as illustrated by the above-described flights during abnormally short growing seasons. Apparently the flights of multiple-generation species with their metropolis in the south retain the two-generation condition to their northern range limit, and are not capable of existing in areas further north, where two normally spaced flights are not possible because of a shorter growing season.

In some multiple-generation species, such as *L. unipuncta* (Haw.), the number of generations a year increases as the length of the growing season increases to the south. Others, such as *L. renigera* (Steph.), retain two generations throughout their entire southern range. The flights of this latter species occur increasingly further apart toward the south, and a progressively longer larval period is probably responsible since Crumb *(7)* found a prolonged active larval period in Tennessee. Other multiple-generation species retain two flights in the south by assuming a quiescent period, which may occur in any life history stage. In Minnesota, where the growing season is relatively short, both generations of larger species must necessarily take place with little or no delay. Certain small species, such as *C. aemula* (Hbn.), *C. americalis* (Gn.), and *E. carneola* Gn., have a relatively short summer generation, and thus probably have one or more slightly prolonged stages. Certain medium-sized species, such as *O. cinereola* (Gn.), and *P. videns* (Gn.), have a summer generation which is slightly shorter than the usual condition found in larger species. With these few exceptions, the approximate appearance of the various life history stages can be calculated when the time of flights is known. For example, a species which flies and oviposits in late May and again in late July must necessarily have gone through a generation during the interval, in which the greatest period was occupied as a larva, a shorter period as a pupa, and still shorter periods as an egg and in the preoviposition stage. Two-generation species in Minnesota must necessarily have one flight early, and one late, in the growing season, and overwintering is most generally as a larva or pupa. Within limitations, those species whose first flight occurs earlier in the season, such as *S. henrici* (Grt.), *P. albilinea* (Hbn.), and *A. falcifera* (Kby.), must necessarily pass the winter as a large larva or pupa; others, whose first flight appears later, such as *L. phragmatidicola* Gn., *L. renigera* (Steph.), and *L. unipuncta* (Haw.), overwinter principally as a smaller larva.

In species having two generations, the first flight was found to be almost always predominantly in May or June, while the second is mostly in July, August, or early September. Exceptions included *C. aemula* (Hbn.), and *L. unipuncta* (Haw.), in which the first flight often, or nearly always, appears predominantly in July. The second flight almost invariably was spread out over a longer period, and Crumb *(7)* has shown that on the northern frontier of the range of multiple-generation species, only a small percentage of the last flight of moths produces offspring which can successfully overwinter. The summer generation was usually completed between 59 days (in the smaller species) and 77 days (in the larger species), and the mean was about 64. Certain species, such as *A. falcifera* (Kby.) and *G. partita* Gn., showed overlapping flights during certain years. In at least many cases, overlapping flights appeared to have been due to weather conditions which were more or less agreeable to oviposition and normal seasonal history progress, but were unfavorable for light trap collections. Hence only an unrepresentative portion of the flight was secured.

In the case of *P. margaritosa* (Haw.) and *L. unipuncta* (Haw.), and certain other of the more widely distributed and more successful species, overlapping catches were apparently due to overwintering in two or possibly more stages. Migration also probably accounted for some overlapping flights, as illustrated by *H. armigera* (Hbn.).

In almost all species, the second flight was much larger than the first, which probably indicates that overwintering mortality usually exceeds that produced by parasites, diseases, and other summer mortality factors. *C. americalis* (Gn.) and *C. aemula* (Hbn.), however, had large July flights, and much smaller second flights late in the season.

ONE-GENERATION SPECIES

These species have but one generation a year throughout their geographical range, and tend to have their metropolis in the north. One or more life cycle stages must be prolonged if a one-generation condition is to be maintained, and such modifications must be progressively longer toward the south. The flight may occur at any time during the season, since time need not be economized. For example, *O. hibisci* Gn. flies very early in the season, *S. inordinata* (Morr.) in June, *E. tessellata* (Harr.) in July, *G. bicarnea* (Gn.) in August, and *A. venerabilis* Wlk. in September. Hence

seasonal histories cannot be so well calculated on the basis of adult flights alone. The flight of a great majority occurred during the last half of July or in August, while somewhat less than half as many species had their flight during the first half of July or in September; a few flew in June or earlier. The greater majority probably overwinters as a larva or an egg, and the former is apparently the more common of the two.

EFFECTS OF METEOROLOGICAL FACTORS

Cook *(2)*, working at University Farm, found that adult catches tend to increase with the rise in temperature and that they decrease when humidity deviates from the optimum of 50 to 55 per cent relative, or when the barometric pressure deviates from the optimum of 2895 to 2900. The further a factor deviates from the optimum, the greater effect it has upon the reduction of the catch. By mathematical studies of partial coefficients, he concluded that pressure is by far the least influential, that humidity is by far the most influential, and that temperature is much more important when the humidity is below the optimum.

The Midland Hills Golf Course light trap was much more accessible to wind, and noticeable quantitative differences in catches were evident at times. Although records of temperature and humidity were taken throughout the last three years of collections, they had no appreciable effect on these studies, and were not included.

Species on the wing only late in August and early in September showed little or no variation in the seasonal appearance as adults. The great majority of those species, which have at least most of the flight before August 1, showed a distinct tendency for the flights to occur progressively earlier in the season each successive year through 1939. The 1940 flights were again delayed in appearance to about the equivalent of those of 1928. The yearly variation in this respect was much less noticeable for those species having no flight before August, and often the sequence, as listed above, was altered. The 1926 season was somewhat retarded, but the initial setback in 1927 was mostly due to the abnormally cold May, June, and part of July. Although May of 1928 was decidedly warmer than usual, April and June were unusually cold, so that the spring temperatures as a whole were below normal; consequently the 1928 flights appeared slightly earlier in the season than those of the previous year. In 1929, temperatures were more nearly normal except for a cool May, and flights therefore ap-

peared earlier than the previous year but were still somewhat retarded because of late development during the two previous years. The 1937 season was about normal. In 1938, the flights occurred much earlier; this was undoubtedly due to a combination of a long and mild growing season and the fact that both seasons of the previous two years were normal or advanced. During the spring of 1939, the temperatures were unusually mild after April 21, and an abnormally long growing season followed. This factor, in combination with the long mild season of the previous year, produced the earliest flights under study, and apparently allowed sufficient time for three flights in some instances. March, April, and May in 1940 were cooler than normal, so that the flights were again delayed in appearance. The greatest variation in seasonal appearance between the extremes of 1927 and 1939 was about 22 days. The mean variation for all species in which a flight was taken at lights before August was about 17 days. This illustrates the great variation that occurs in the seasonal history of a species from year to year, and the futility of attempting to make a definite date-schedule without detailed knowledge of the ecology of each species on the background of seasonal variations.

The flights of certain species were much more influenced by weather conditions. *P. albilinea* (Hbn.) held very strictly to seasonal history rhythm despite daily weather fluctuations, and showed almost ideal flight curves. Others, such as *L. renigera* (Steph.), were greatly modified.

LIGHT TRAP STUDIES

Males, in general, outnumbered females at lights about three to one. Extreme sex ratios were 156 males to one female in *N. emmedonia* (Cram.), and 16.2 females to one male in *A. subflava* (Grt.).

Four species were studied with special reference to light trap reliability in determining seasonal history. These were *F. ducens* Wlk., *L. renigera* (Steph.), *P. albilinea* (Hbn.), and *C. devastator* (Brace). The light trap collections of these were found, with minor exceptions, to be representative of the actual conditions as shown by ovariole dissections and hand collections. In almost all species, light trap catches approximated the true seasonal history. These striking exceptions were noted: (1) the first flight of *C. erechtea* (Cram.) was made up almost entirely of small males, and only a small percentage of the females was taken in the preoviposition stage; however, in no other species did the sex

ratio vary greatly during the flight; (2) several other species were characterized by the smaller number of spent females taken at lights, as indicated by the second 1940 flight of *L. unipuncta* (Haw.), which was practically all in the preoviposition stage; (3) in *A. falcifera* (Kby.) there was a tendency for the spent females to come to lights in increasing numbers toward the end of the flight, although very few females, and practically no gravid ones, were taken during the entire flight period; (4) *S. clandestina* (Harr.), a one-generation species, showed two concentrations of catches due to a prolonged period of adulthood, in which activity is slowed up during the middle portion of the season, this condition being detected by egg dissections; and (6) *H. armigera* (Hbn.) catches were unrepresentative because this species is not usually attracted to lights until after oviposition, and certain specimens apparently fly up from the south late in the season. Species of this type may be detected by hand collections, ovariole dissections, and field observations. A few other species, not so well known, may have similar abnormal characteristics as described above and are liable to incorrect interpretations by flight analysis exclusively. Overlapping catches are deceptive but are usually recognized because of the short duration between peaks, which would not allow time for a complete generation.

Light traps operate continuously, and with equal magnitude, over a long period of time, a condition which cannot be physically or economically duplicated or equaled by hand collections, field observations, or any other method. For this reason they are one of the best and most practical methods of studying the seasonal history of the Phalaenids, which are notorious for their attraction to lights. However, as pointed out above, light trap studies should be supplemented with other types of studies in certain instances. Further reliability of light trap catches is shown by a comparison of the daily catches of the Midland Hills and University Farm traps; the same general daily trends were apparent between them throughout the entire three years of operation, although located two miles apart in a different habitat. The variations shown in light trap catches from year to year illustrate the necessity of collections over a period of years (preferably several lights), but this is also necessary in other types of seasonal history studies.

Data on Less Common and Less Destructive Species

Name	Collections				Probable number of generations
	Total	Light trap	Month of maximum	Extreme dates	
Charadra deridens (Gn.)	19	5	June	May 13-July 24	1
Raphia abrupta Grt.	9	0	July	June 3-August 2	1?
Raphia frater Grt.	33	5	July	May 18-August 16	1?
Acronicta dactylina (Grt.)	25	0	June	May 29-July 17	1
Acronicta lepusculina Gn.	20	1	June, August	June 15-August 29	2
Acronicta falcula (Grt.)	12	8	June	May 30-June 22	2
			August	July 26-August 12	
Acronicta vinnula (Grt.)	13	12	June	June 1-20	2
			August	July 16-August 7	
Acronicta ovata Grt.	9	0	July	June 25-July 22	1?
Acronicta inclara inconstans Sm.?	8	8	August	July 14-August 17	1?
Acronicta sperata Grt.	14	1	June	May 20-July 17	1
Acronicta oblinata (A. and S.)	12	2		April 27-August 20	2
Euxoa dargo (Stkr.)	16	3	September	August 19-September 31	1
Euxoa niveilinea (Grt.)	40	35	August	August 4-September 27	1
Euxoa quadridentata (G. and R.)	5	1	September	August 29-September 21	1
Euxoa albipennis malis (Sm.)	16	2	August	July 1-September 11	1
Euxoa divergens (Wlk.)	10	1	July	June 24-August 7	1
Euxoa redimicula (Morr.)	11	7	August	July 11-August 27	1
Euxoa tristicula (Morr.)	8	2	July	June 20-July 28	1
Onychagrotis rileyana (Morr.)	10	5	September	September 2-15	1
Agrotis volubilis Harv.	47	14	May	May 5-July 21	1
Eurois astricta Morr.	12	1	July	July 17-August 1	1
Paradiarsia littoralis (Pack.)	38	13	June	June 7-July 27	1
Pseudospaelotis haruspica (Grt.)	64	50	July	June 21-August 16	1
Graphiphora collaris (G. and R.)	24	13	September	August 14-September 15	1
Graphiphora tennicola (Morr.)	23	21	August	July 6-August 31	1
Anaplectoides pressus (Grt.)	7	0		June 29-August 2	1
Cryptocala acadiensis (Beth.)	9	4	July	July 13-30	1
Eueretagrotis sigmoides (Gn.)	24	0	July	July 3-22	1
Rhynchagrotis cupida (Grt.)	11	2	August	July 23-September 15	1
Polia imbrifera (Gn.)	16	1	July	June 11-July 13	1
Polia purpurissata (Grt.)	71	8	August	July 17-September 5	1
Polia grandis (Bdv.)	38	5		May 15-August 16	2?
Polia subjuncta (G. and R.)	46	24	June	May 26-July 13	2
			August	July 24-August 26	
Polia legitima (Grt.)	16	13	July	July 12-August 10	1
Polia lilacina (Harr.)	15	7	July	June-August 9	1
form *illabefacta* (Morr.)	8	5	July	July 11-August 12	
Polia adjuncta (Bdv.)	30	18	June	May 5-June 24	2
			August	July 20-August 31	
Polia cristifera (Wlk.)	10	1	June	June 12-July 8	1
Polia detracta (Wlk.)	10	6	June	June 6-July 14	1
Polia detracta neoterica Sm.	54	24	June	June 8-July 9	1
Lacinipolia vicina (Grt.)	49	21	June	May 26-June 25	2
			July	July 11-August 15	
Lacinipolia olivacea (Morr.)	24	7	June	June 10-13	2
			August	July 29-August 28	
Sideridis rosea (Harv.)	16	3	June	May 26-June 26	1
Anepia capsularis (Gn.)	8	4	June	May 31-July 10	1
Tricholita signata (Wlk.)	27	17	August	July 7-August 20	1
form *igna* B. and B.	4	0		June-August 15	
Orthodes oviduca (Gn.)	274	248	June	May 10-July 12	1
Orthodes crenulata (Butl.)	21	19	July	June 12-August 6	1
Orthodes contrahans (Wlk.)	9	3	July	July 6-26	1
Orthodes furfurata (Grt.)	9	7	July	July 12-August 4	1
Morrisonia evicta Grt.	10	2	May	May 5-26	1
Orthosia hibisci Gn.	18	6	April	April 4-June 21	1

Data on Less Common and Less Destructive Species—Cont.

Name	Collections				Probable number of generations
	Total	Light trap	Month of maximum	Extreme dates	
Crocigrapha normani (Grt.)	10	4	May	May 4-June 9	1
Leucania pseudargia Gn.	34	22	July	June 24-September 8	1
Leucania multilinea Wlk.	27	24	July	May 27-September 6	1
Leucania insueta Gn.	20	14	June	June 5-July 8	1
Cucullia speyeri Lint.	14	14	June	May 25-July 2	2?
			August	July 21-August 12	
Cucullia asteroides Gn.	21	8	June	May 24-September 17	1
Psaphidia resumens Wlk.	12	12	April	April 27-May 7	1
Psaphidia grotei (Morr.)	9	1	May	April 12-May 18	1
Graptolitha ferrealis (Grt.)	8	0		September-April	1
Graptolitha laticinerea (Grt.)	16	1	April	September 15-April 27	1
Xylena nupera Lint.	7	1	April	April 20-May 11	1
Xylena curvimacula (Morr.)	11	0	April	September 19-April 22	1
Anytus privata (Wlk.)	7	1	September	August 29-September 17	1
Eupsilia tristigmata (Grt.)	14	0	April	April 1-May 3	1
Eupsilia sidus (Gn.)	44	1	April	March 15-April 25	1
Eupsilia morrisoni (Grt.)	21	0	April	September 15-May 4	1
Eupsilia devia (Grt.)	13	0	April	April 4-25	1
Xystopeplus rufago (Hbn.)	9	0	April	April 4-18	1
Rusina bicolorago form *ferrugineoides* (Gn.)	43	25	September	August 3-October 22	1
Xanthia lutea (Strom.)	12	1	September	July 3-September 21	1
Anathix puta (G. and R.)	50	16	September	July 13-October 4	1
Eucirrhoedia pampina Gn.	40	21	September	August 31-September 28	1
Septis verbascoides (Gn.)	8	1	July	June 29-July 29	1
Septis cariosa (Gn.)	11	6	July	June 16-August 29	1?
Septis apamiformis (Gn.)	9	3	July	July 1-August 17	1
Septis alia (Gn.)	7	5	July	June 20-July 9	1
form *rorulanta* (Sm.)	1	0		June 20	
Septis indocilis form *separans* (Grt.)	6	5	July	June 10-July 9	1
Septis finitima (Gn.)	46	40	June	May 27-July 7	1
Agroperina lateritia (Hufn.)	8	0	June	June 20-July 3	1
Agroperina lutosa (Andr.)	14	9	July	June 30-August 12	1
Agroperina helva (Grt.)	54	36	August	July 20-September 5	1
Luperina passer (Gn.)	23	20	July	June 19-October 9	1?
Oligia modica (Gn.)	24	12	July, August	June 19-September 9	1?
Oligia diversicolor (Morr.)	6	4	August	August 5-September 7	1
Oligia mactata (Gn.)	15	1	July	June 10-July 12	2?
			September	August 30-October 1	
Eremobia jocasta Sm.	14	13	August	July 11-September 14	1
Archanara oblonga (Grt.)	25	16	August	July 8-September 5	1
Hypocoena rufostrignata (Pack.)	9	2	July	June 16-August 7	1?
Hypocoena variana (Morr.)	12	11	July	July 23-August 12	1
Ipimorpha subvexa (Grt.)	6	0	August	July 20-August 26	1?
Helotropha reniformis (Grt.)	62	52	August	June 27-September 21	1?
form *atra* (Grt.)	4	4		July 26-August 20	
Hydroecia perobliqua Hamp.	10	0	July	July 3-August 14	1
Hydroecia stramentosa Gn.	9	7	August	August 8-September 4	1
Papaipema margindens (Gn.)	9	3	August	August 5-September 15	1
Papaipema rigida (Grt.)	5	4	August	July 2-September 15	1
Papaipema sciata Bird	9	9	September	September 11-October 4	1
Phlogophora iris Gn.	32	6	June	June 4-July 2	1
Euherrichia monetifera (Gn.)	8	1	June	May 31-July 30	1
Trachea delicata (Grt.)	27	21	June, July	May 28-August 25	2?
Chytonix palliatricula (Gn.)	18	7	July	May 17-July 31	1
form *iaspis* (Gn.)	3	1		July 1-August 10	

Data on Less Common and Less Destructive Species—Cont.

Name	Collections				Probable number of generations
	Total	Light trap	Month of maximum	Extreme dates	
Leuconycta diphteroides (Gn.)	24	6	June	May 25-July 24	1
form *obliterata* (Grt.)	5	1	June	June 1-July 10	
Leuconycta lepidula (Grt.)	12	0	June	May 28-July 20	1
form *aririda* (Sm.)	1	0		June 1	
Agriopodes teratophora (H.S.)	12	0	June	May 23-June 23	1
Amphipyra glabella (Morr.)	10	10	July	July 19-September 9	1
Dipterygia scabriuscula (L.)	48	30	June	May 30-June 29	2
			August	July 14-September 22	
Delta ramosula (Gn.)	19	18	May	April 27-June 12	2
			August	July 4-September 14	
Hyppa xylinoides Gn.	29	15	May	May 15-June 31	2
			August	July 17-September 22	
Platysenta vecors (Gn.)	9	1	July	May 15-September 2	2?
Arzama obliqua (Wlk.)	20	11	June	May 29-August 5	1
Achatodes zeae (Harr.)	9	9	July	July 5-August 15	1
Pyrrhia umbra experimens (Wlk.)	30	23	June	June 7-August 17	1?
Catabena lineolata Wlk.	42	25	June	May 17-June 11	2
			July	July-August 24	
Stibadium spumosum Grt.	16	7	August	July 24-August 25	1
Plagiomimicus pityochromus Grt.	7	6	August	July 26-August 12	1?
Plagiomimicus expallidus Grt.	42	35	August	July 24-August 25	1
Stiria rugifrons Grt.	7	0	August	August 4-September 11	1?
Euthisanotia grata (Fabr.)	30	6	July	June 10-July 26	1
Euthisanotia unio Hbn.	8	2	July	June-August 16	1
Heliothis paradoxa (Grt.)	34	32	June	June 18-July 4	2
			August	July 14-September 4	
Heliothis phloxiphaga G. and R.	11	5		May 18-October 5	2
form *luteitinctus* Grt.	3	1			
Canthylidia scutosa (Schiff.)	18	11	June	May 24-August 26	2?
Dasyspoudaea lucens (Morr.)	39	17	July	June 9-August 1	1
Rhodophora florida Gn.	20	12	August	July 10-August 25	1
Schinia trifascia Hbn.	8	6	August	July 28-August 30	1?
Schinia nundina (Dru.)	10	7	August	July 30-September 9	1
Schinia tertia (Grt.)	33	26	August	August 1-September 19	1
Schinia thoreaui (G. and R.)	8	4	August	July 26-August 16	1?
Schinia marginata (Haw.)	25	20	August	June 24-September 5	1
Schinia jaguarina (Gn.)	9	3	July	June 14-July 13	1
Schinia lynx (Gn.)	40	38	June	June 21-July 9	2?
			August	July 28-August 18	
Schinia mortua (Grt.)	64	63	August	July 9-September 31	1
Erastria muscosula Gn.	11	0	June	June 10-July 14	1
Erastria synochitis G. and R.	39	31	July	June 12-July 26	1
Tarachidia erastrioides (Gn.)	84	60	June, July	May 8-August 28	2
Acontia arida Sm.	15	15	September	September 2-7	1
Marathyssa inficita (Wlk.)	26	21	July	May 31-September 5	1?
Autographa putnami (Grt.)	15	13		May 21-September 15	2?
Plusia aereoides Grt.	25	18	July	June 22-August 28	1
Plusia aerea (Hbn.)	33	27	June, August	June 16-September 8	2
Plusia ballaca (Geyer)	8	5	July	July 7-August 29	1?
Pseudeva purpurigera (Wlk.)	13	7	July	July 5-31	1
Palaeoplusia venusta (Wlk.)	14	9	July	June 10-July 24	1
Catocala unijuga Wlk.	12	0	August	July 7-September 17	1
Catocala luciana Stkr.	22	0	July	June 24-September 13	1
form *somnus* Dodge	6	0		June 24-August 26	
Catocala concubens Wlk.	19	3	July	June 24-September 17	1

Data on Less Common and Less Destructive Species—Cont.

Name	Collections				Probable number of generations
	Total	Light trap	Month of maximum	Extreme dates	
Catocala ultronia (Hbn.)	6	3	July	July 20-August 2	1
form *adriana* Hy. Edw.	2	0			
form *lucinda* Beut.	8	0	July	July 1-August 4	
Catocala grynea (Cram.)	15	12	July	July 8-August 20	1
Catocala amica (Hbn.)	42	9	August	July 12-September 15	1
Euclidina cuspidea (Hbn.)	23	1	June	May 17-August 1	1
Caenurgina crassiuscula (Haw.)	201	92	May, July	April 1-September 8	2
Zale lunata (Dru.)	13	1	August	July 11-September 30	1
Zale galbanata (Morr.)	53	12	June	May 5-July 3	2
			July	July 11-October 2	
Zale undularis (Dru.)	10	1	June	May 6-July 26	1
Zale lunifera (Hbn.)	15	0		April 10-August 9	2?
Panopoda rufimargo (Hbn.)	31	6	July	June 10-July 18	1
Calpe canadensis Beth.	18	1	July	June 30-August 6	1
Scoliopteryx libatrix (L.)	75	8	July, winter	January 19-December 3	2
Bomolocha palparia Wlk.	12	1	June	June 19-July 3	1
Bomolocha deceptalis (Wlk.)	7	2	July	June 22-August 3	1?
Rivula propinqualis Gn.	35	30	August	June 22-September 7	1?
Camptylochila lubricalis Geyer	46	11	July, August	June 23-September 16	1?
Epizeuxis laevigata (Grt.)	12	0	July	July 8-August 2	1
Epizeuxis ochreipennis (Grt.)	37	16	July	July 3-23	1
Philometra hanhami Sm.	13	8	July	July 2-31	1
Renia flavipunctalis (Geyer)	64	24	July	June 30-August 15	1

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PLATES I-XXII

Graphic representations of the flights of 54 of the more common species, as determined by light trap catches.

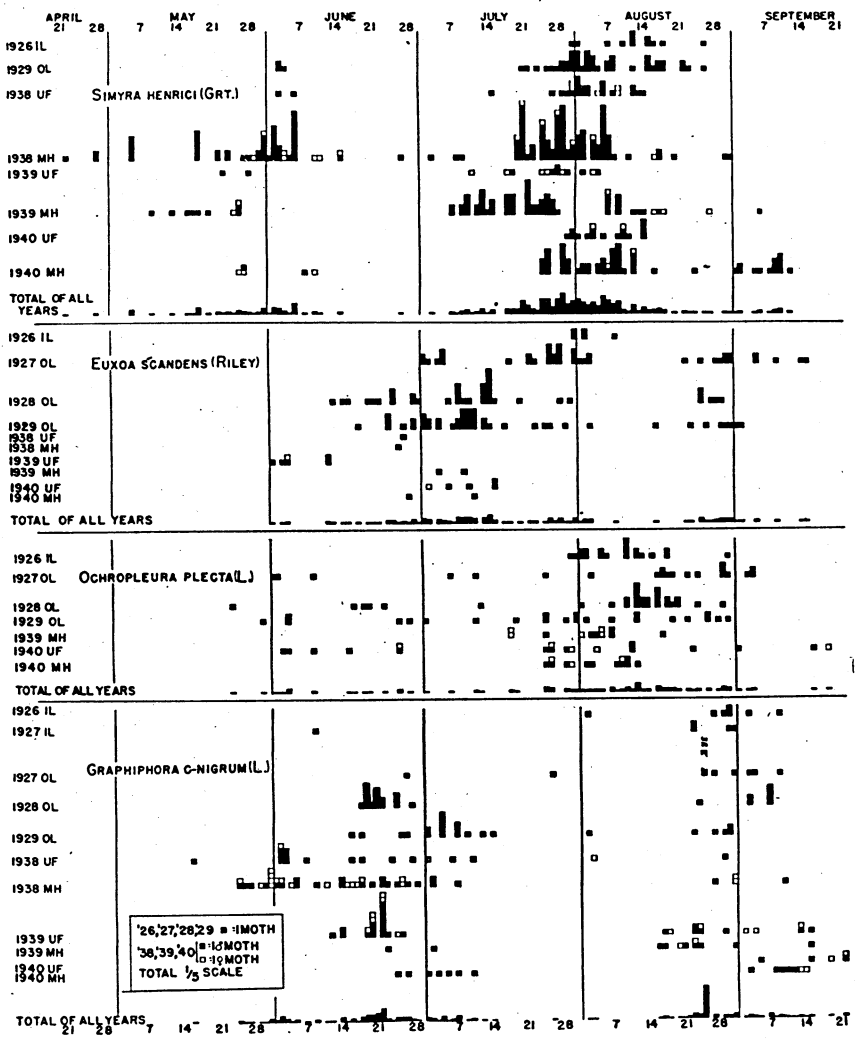
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
SIMYRA HENRICI (GRT.)
EUXOA SCANDENS (RILEY)
OCHROPLEURA PLECTA (L.)
GRAPHIPHORA C-NIGRUM (L.)
TOTAL OF ALL YEARS
'26, '27, '28, 29 = 1 MOTH
'38, '39, '40 = 1 MOTH
TOTAL 1/5 SCALE

Plate I

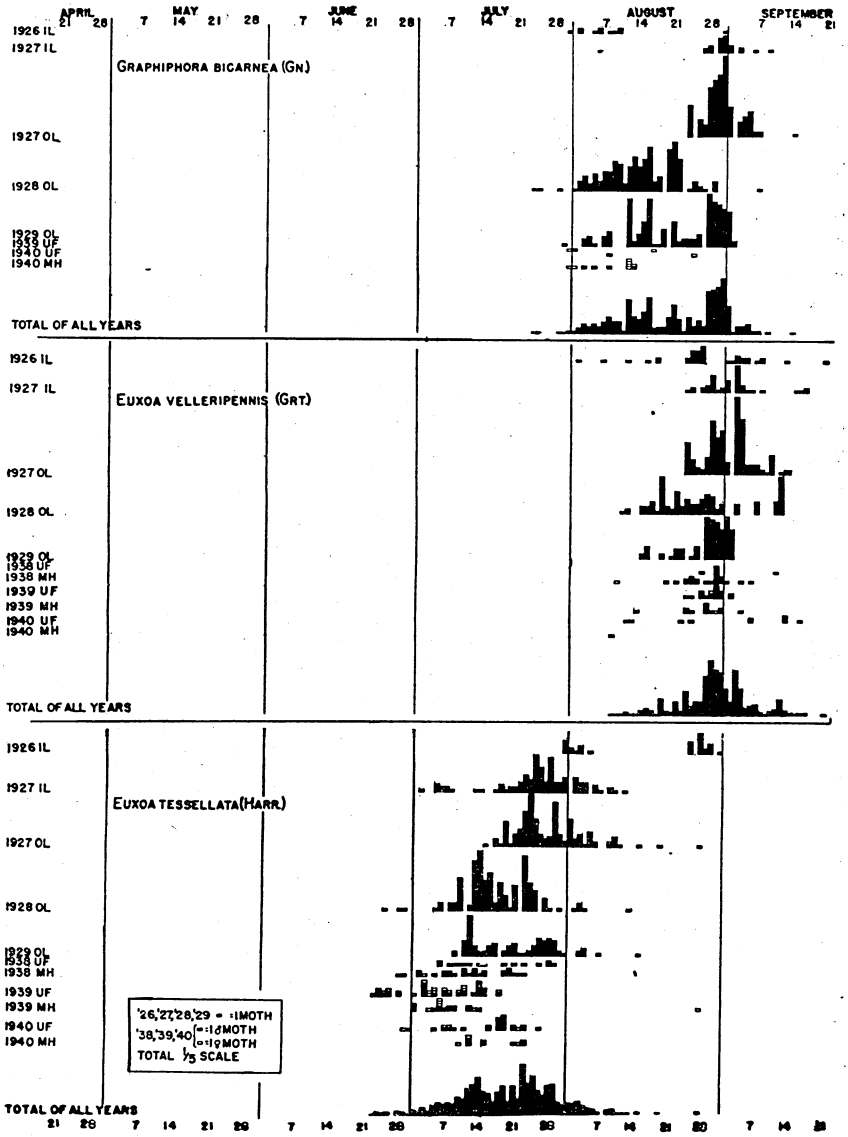
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
GRAPHIPHORA BICARNEA (GN.)
1927 OL
1928 OL
1929 OL
1938 UF
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
EUXOA VELLERIPENNIS (GRT.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
EUXOA TESSELLATA(HARR.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28

Plate II

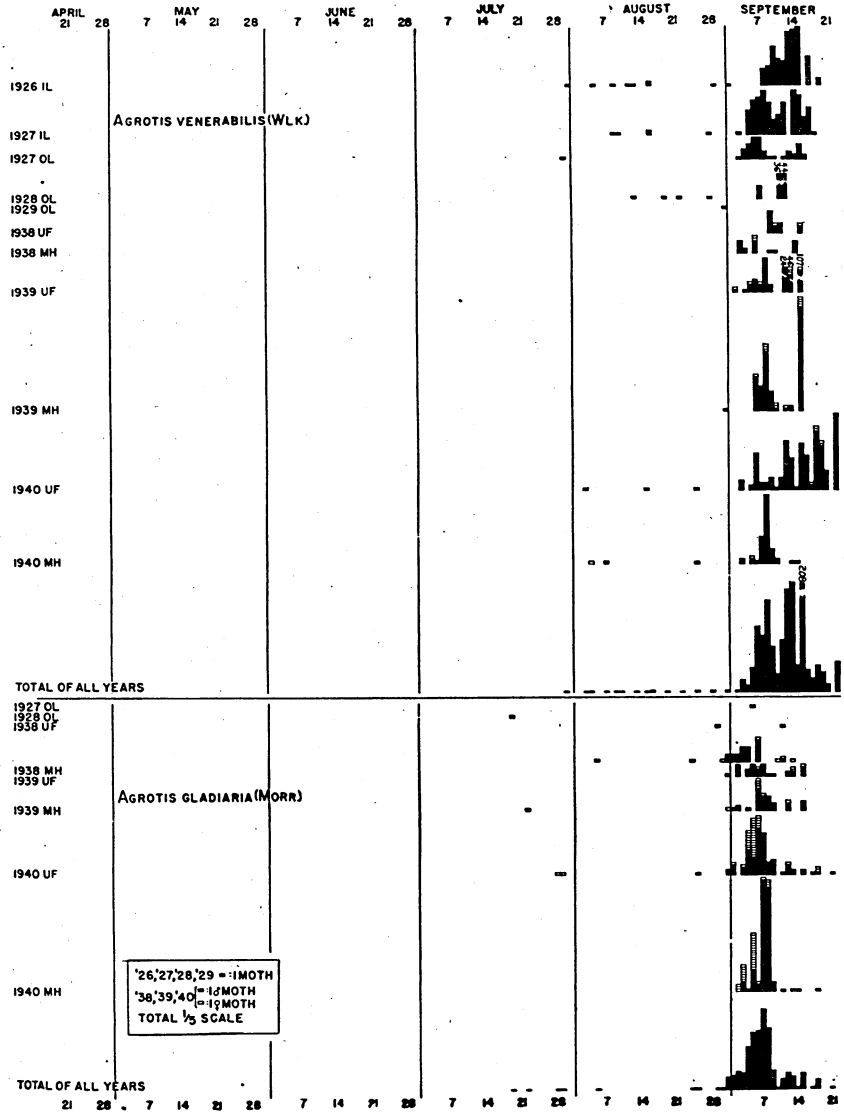
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
AGROTIS VENERABILIS (WLK.)
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1927 OL
1928 OL
1938 UF
1938 MH
1939 UF
AGROTIS GLADIARIA (MORR.)
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate III

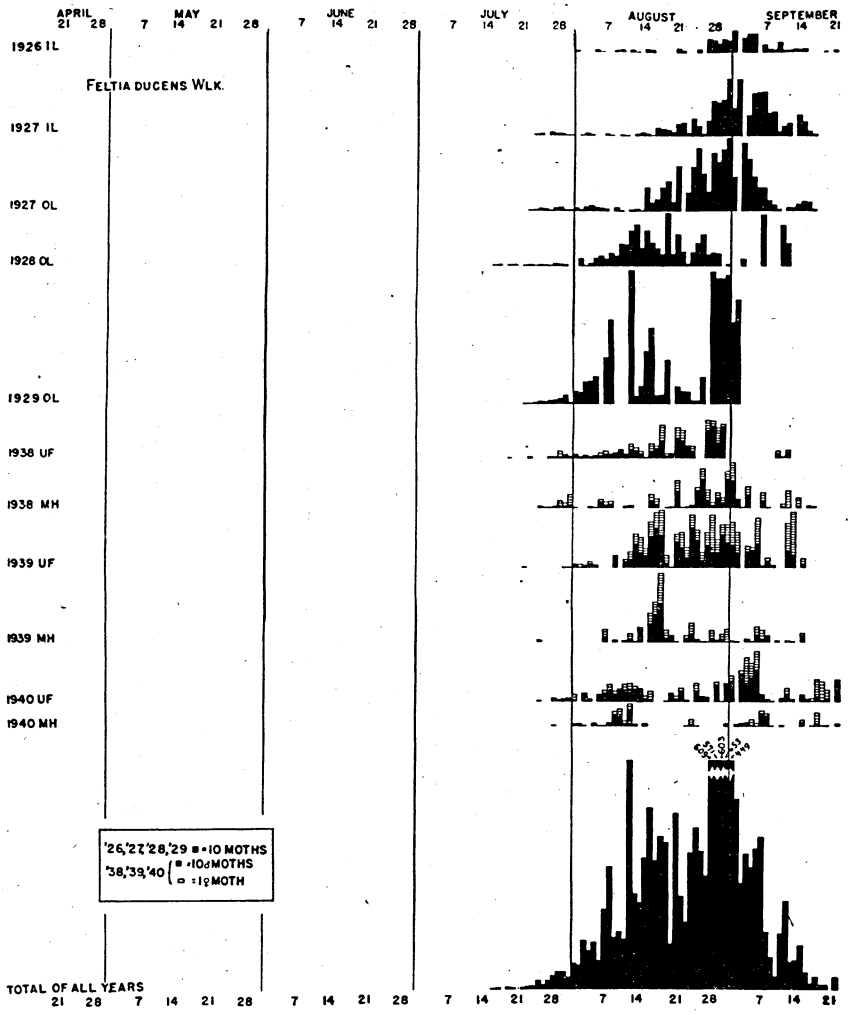
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
FELTIA DUCENS WLK.
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 10 MOTHS
'38,'39,'40 = 10♂MOTHS
= 1♀MOTH
TOTAL OF ALL YEARS

Plate IV

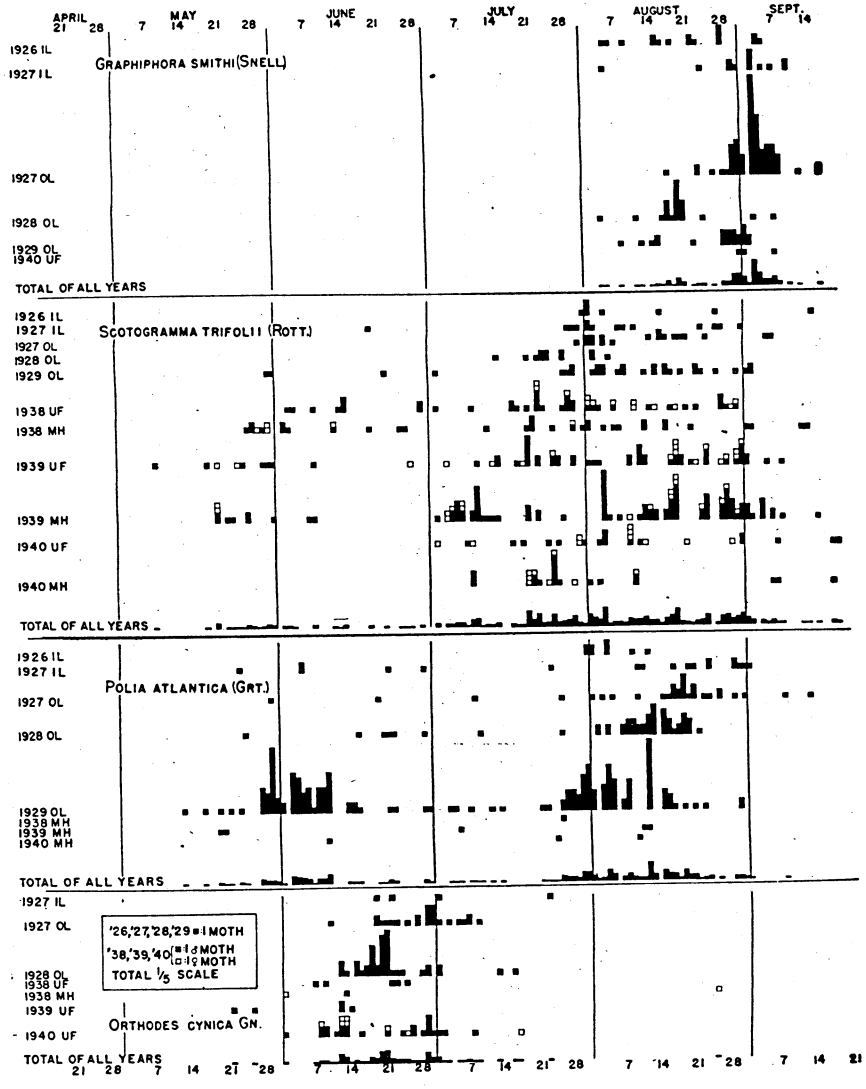
APRIL 21 28
MAY 7 14 21 28
JUNE 7 14 21 28
JULY 7 14 21 28
AUGUST 7 14 21 28
SEPT. 7 14
1926 IL
1927 IL
GRAPHIPHORA SMITHI (SNELL)
1927 OL
1928 OL
1929 OL
1940 UF
TOTAL OF ALL YEARS
1926 IL
1927 IL
SCOTOGRAMMA TRIFOLII (ROTT.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
POLIA ATLANTICA (GRT.)
1927 OL
1928 OL
1929 OL
1938 MH
1939 MH
1940 MH
TOTAL OF ALL YEARS
1927 IL
1927 OL
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 (♂ = 1 MOTH
(♀ = 1 MOTH
TOTAL 1/5 SCALE
1928 OL
1938 UF
1938 MH
1939 UF
1940 UF
ORTHODES CYNICA GN.
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate V

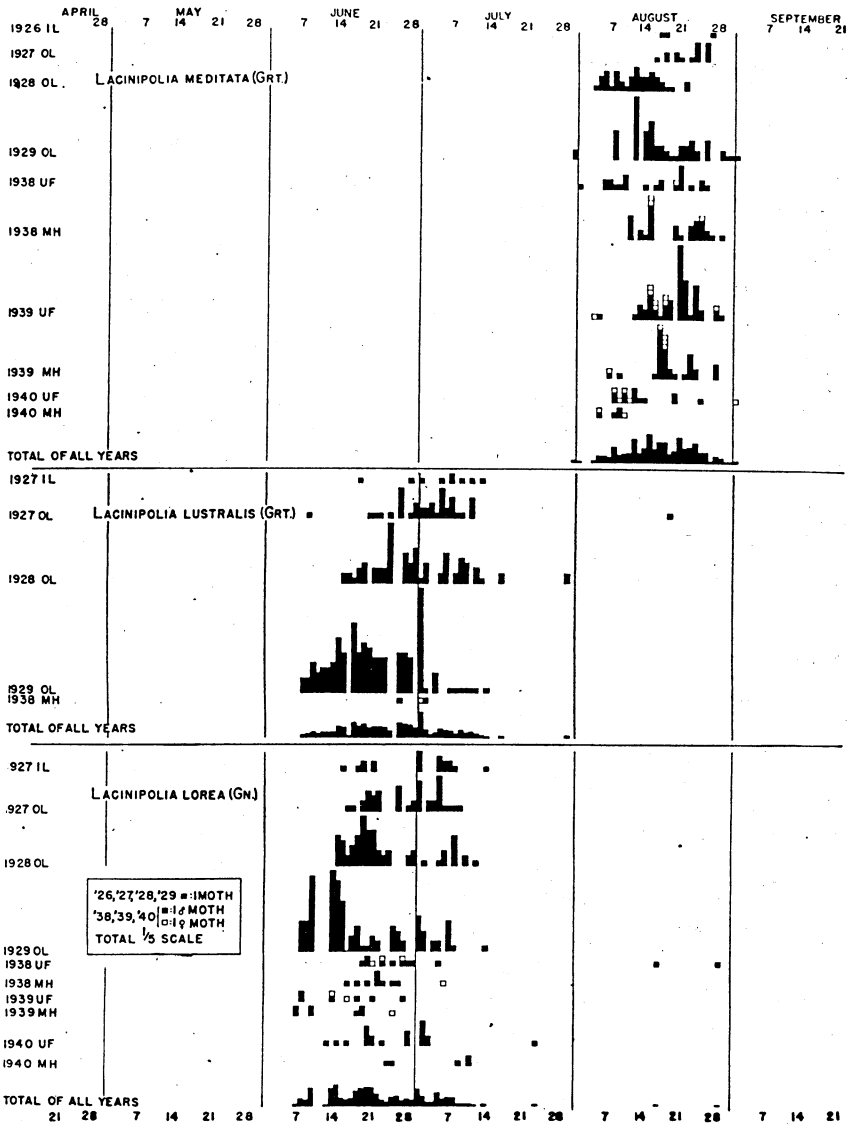
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1926 IL
1927 OL
1928 OL
LACINIPOLIA MEDITATA (GRT.)
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1927 IL
1927 OL
LACINIPOLIA LUSTRALIS (GRT.)
1928 OL
1929 OL
1938 MH
TOTAL OF ALL YEARS
1927 IL
LACINIPOLIA LOREA (GN.)
1927 OL
1928 OL
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1 ♂ MOTH
= 1 ♀ MOTH
TOTAL 1/5 SCALE
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS

Plate VI

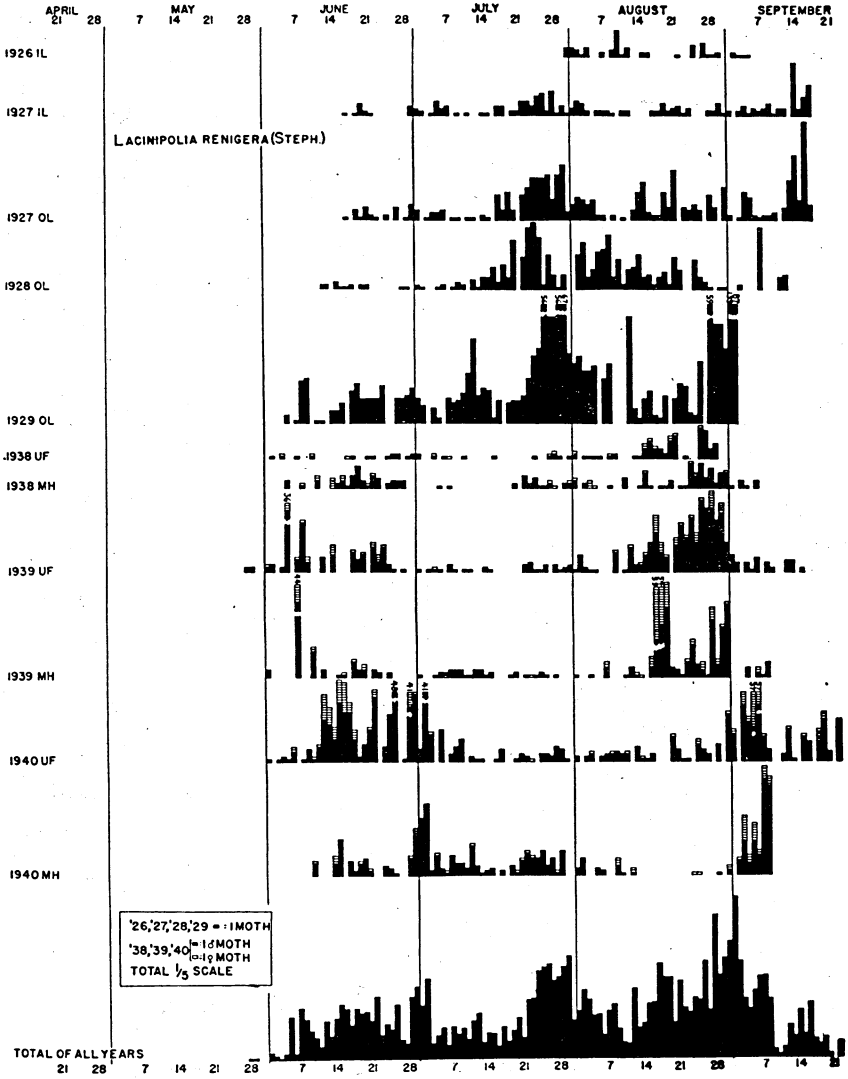
APRIL
21 28
MAY
7 14 21 28
JUNE
7 14 21 28
JULY
7 14 21 28
AUGUST
7 14 21 28
SEPTEMBER
7 14 21
1926 IL
1927 IL
LACINIPOLIA RENIGERA (STEPH.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate VII

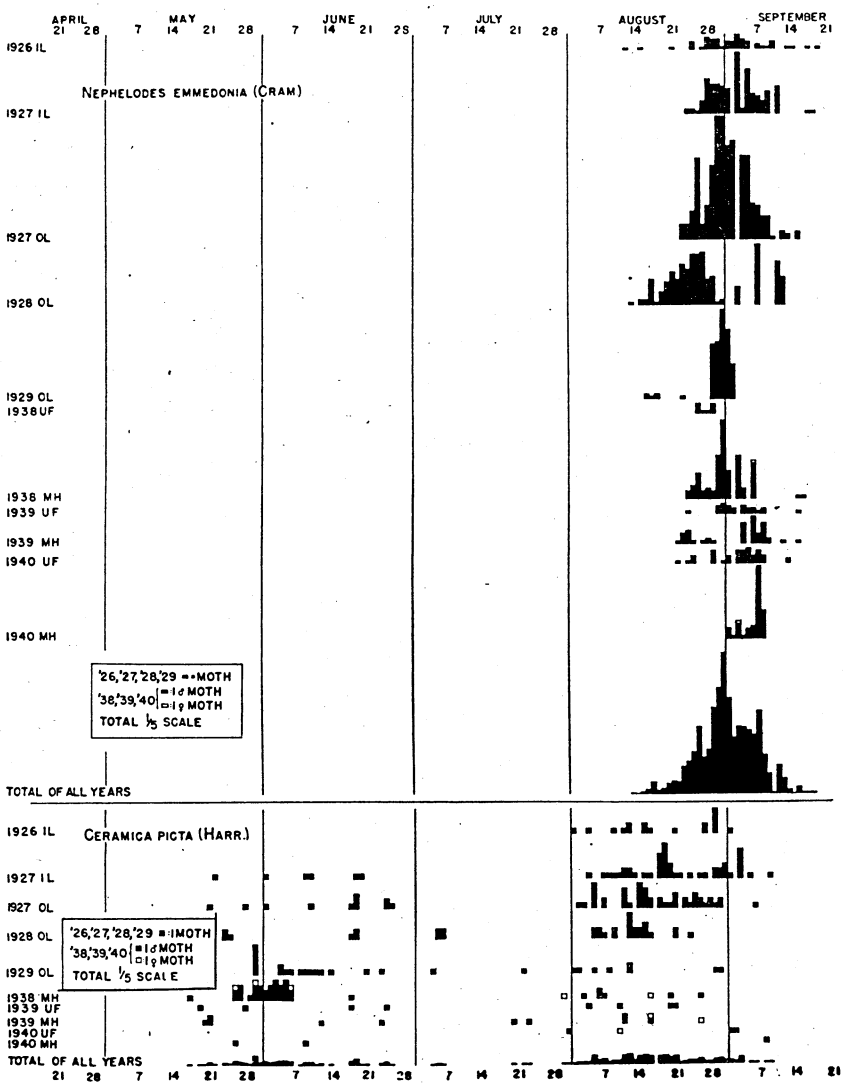
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
NEPHELODES EMMEDONIA (CRAM)
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
1926 IL
CERAMICA PICTA (HARR.)
1927 IL
1927 OL
1928 OL
1929 OL
'26,'27,'28,'29 = MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate VIII

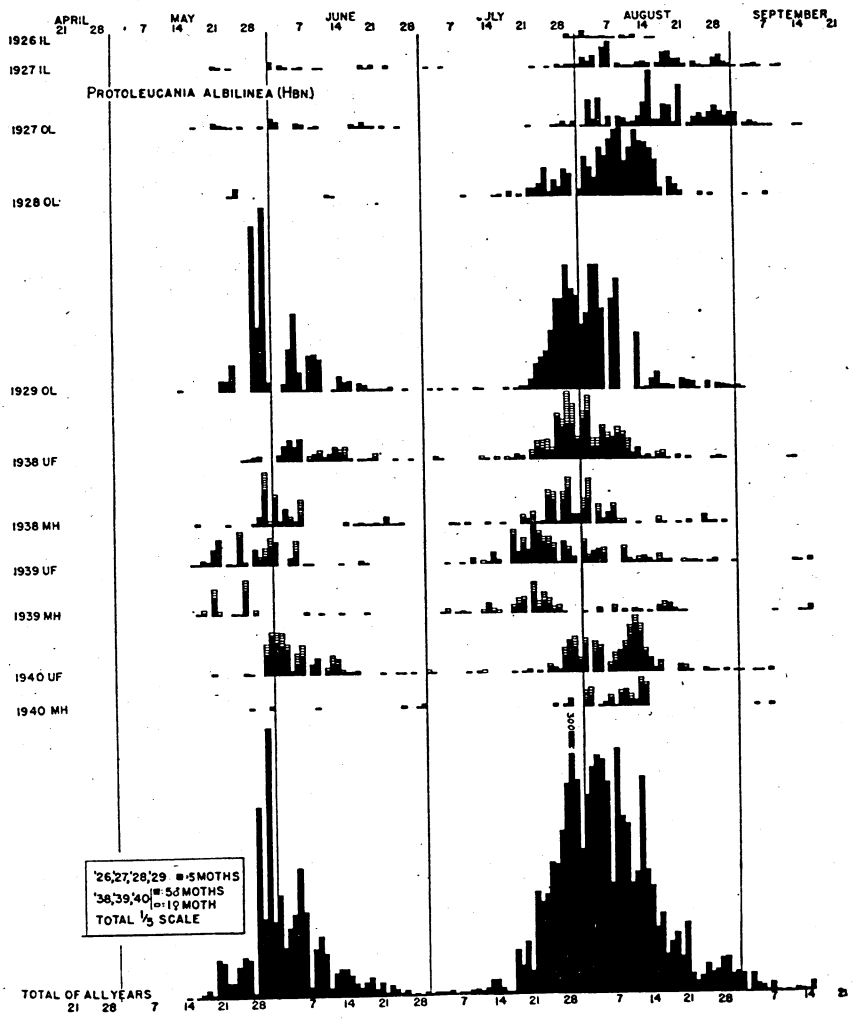
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
PROTOLEUCANIA ALBILINEA (HBN)
1926 IL
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 ■=5 MOTHS
'38,'39,'40 ■=5 MOTHS
▭=1 MOTH
TOTAL 1/3 SCALE
TOTAL OF ALL YEARS

Plate IX

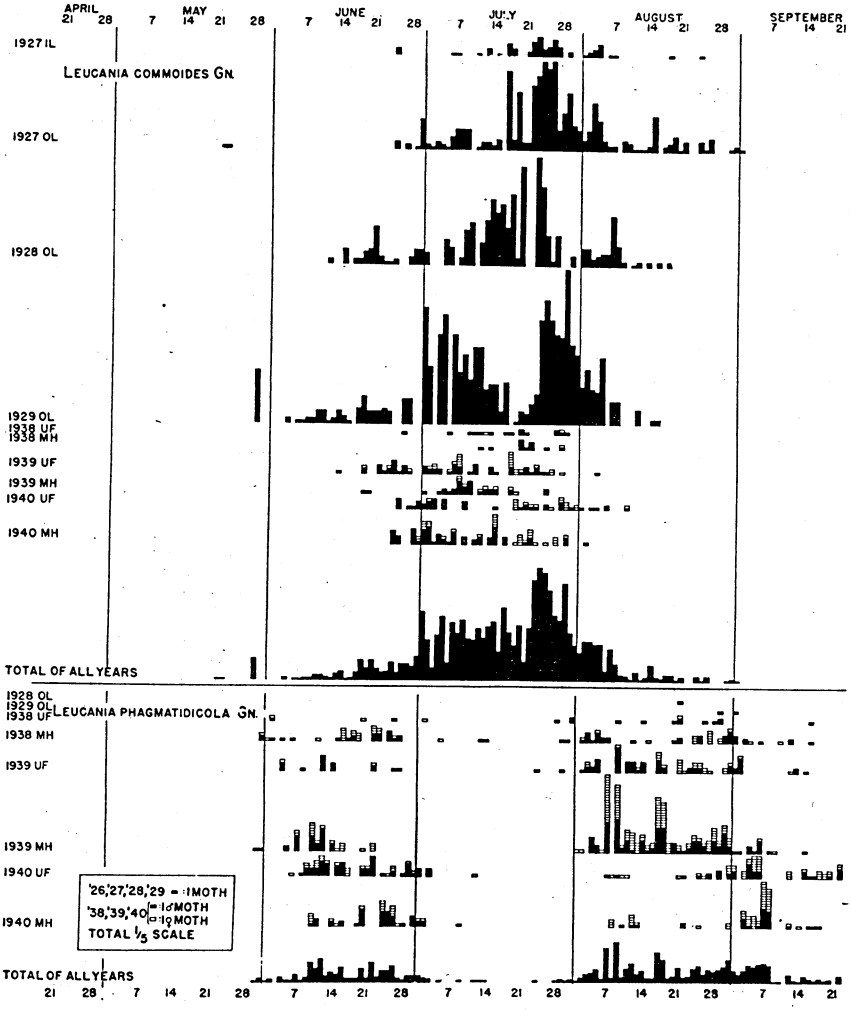
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1927 IL
LEUCANIA COMMOIDES GN.
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1928 OL
1929 OL
1938 UF
LEUCANIA PHAGMATIDICOLA GN.
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS

Plate X

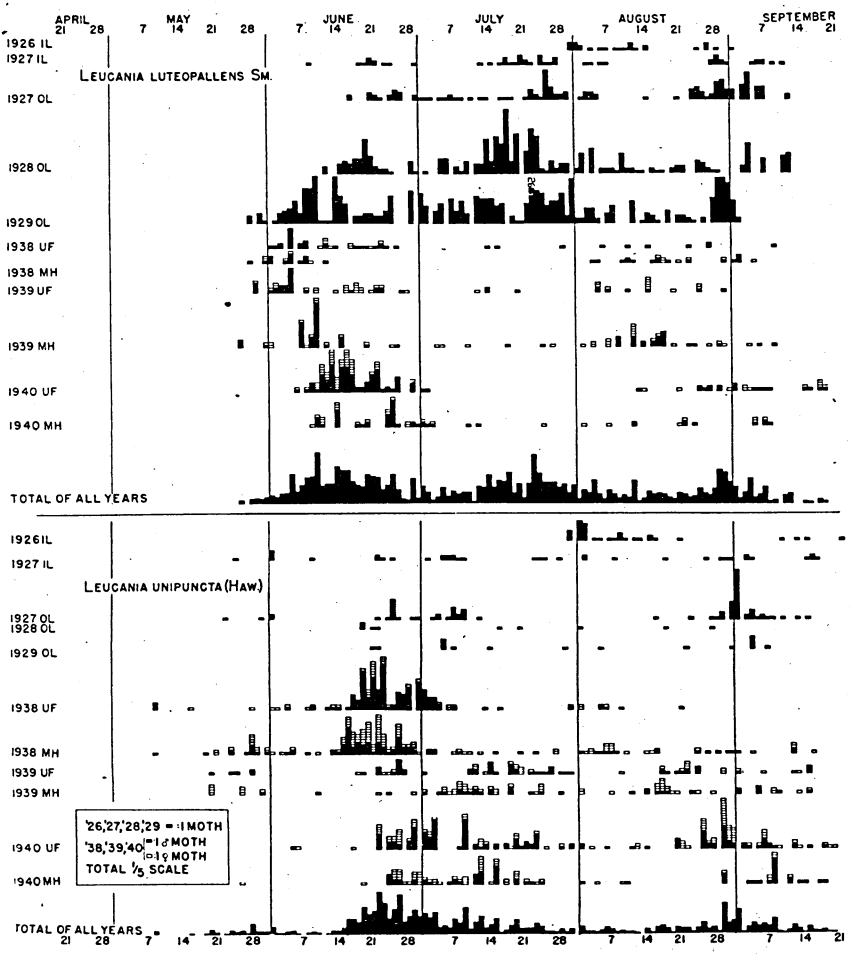
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
LEUCANIA LUTEOPALLENS Sm.
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
LEUCANIA UNIPUNCTA (Haw.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XI

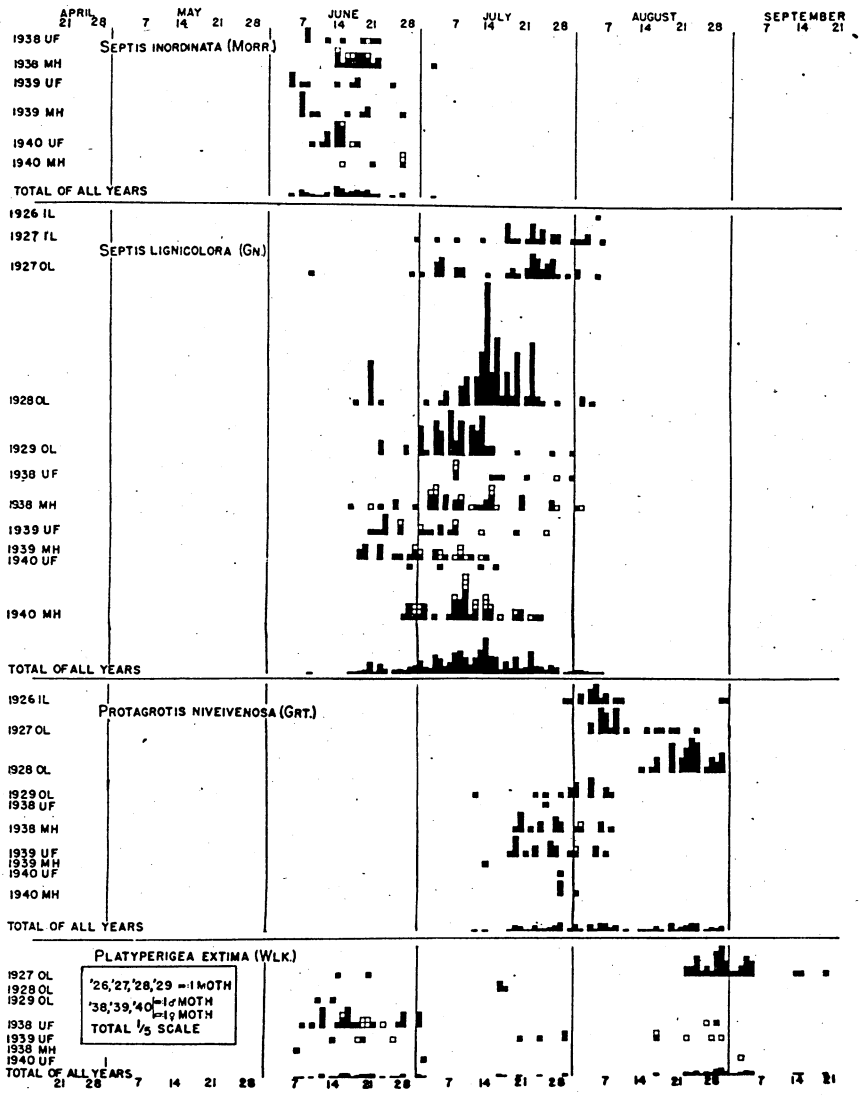
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
SEPTIS INORDINATA (MORR.)
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
SEPTIS LIGNICOLORA (GN.)
1926 IL
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
PROTAGROTIS NIVEIVENOSA (GRT.)
1926 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
PLATYPERIGEA EXTIMA (WLK.)
1927 OL
1928 OL
1929 OL
1938 UF
1939 UF
1938 MH
1940 UF
TOTAL OF ALL YEARS
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
= 1♀ MOTH
TOTAL 1/5 SCALE

Plate XII

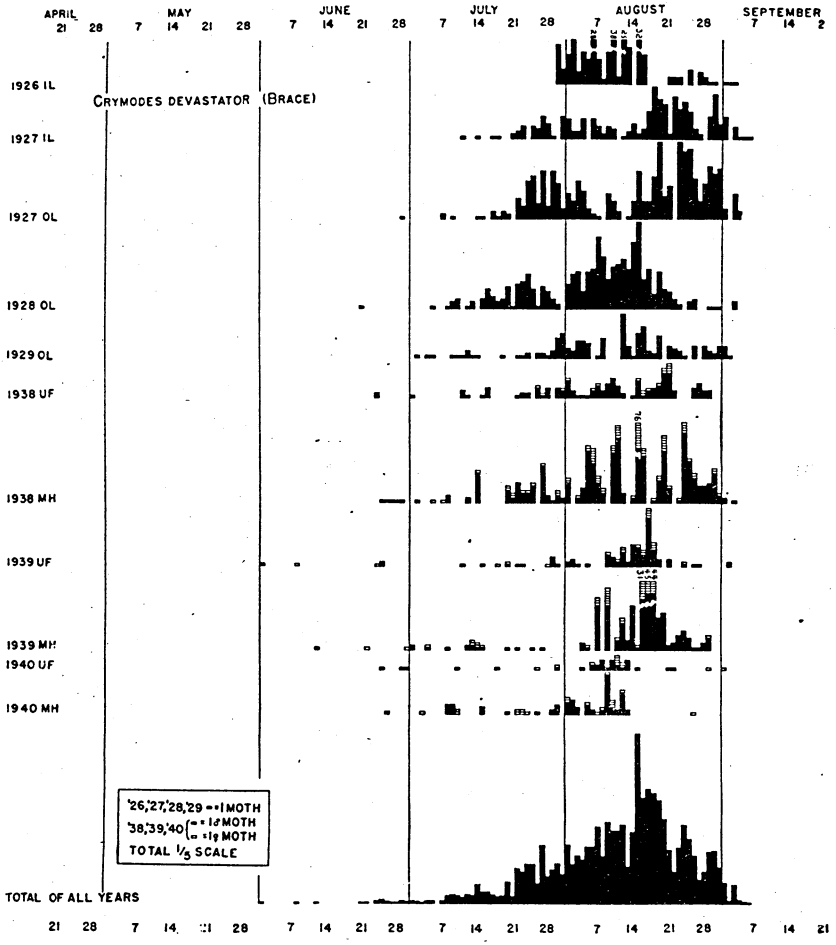
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 2
1926 IL
CRYMODES DEVASTATOR (BRACE)
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1/2 MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XIII

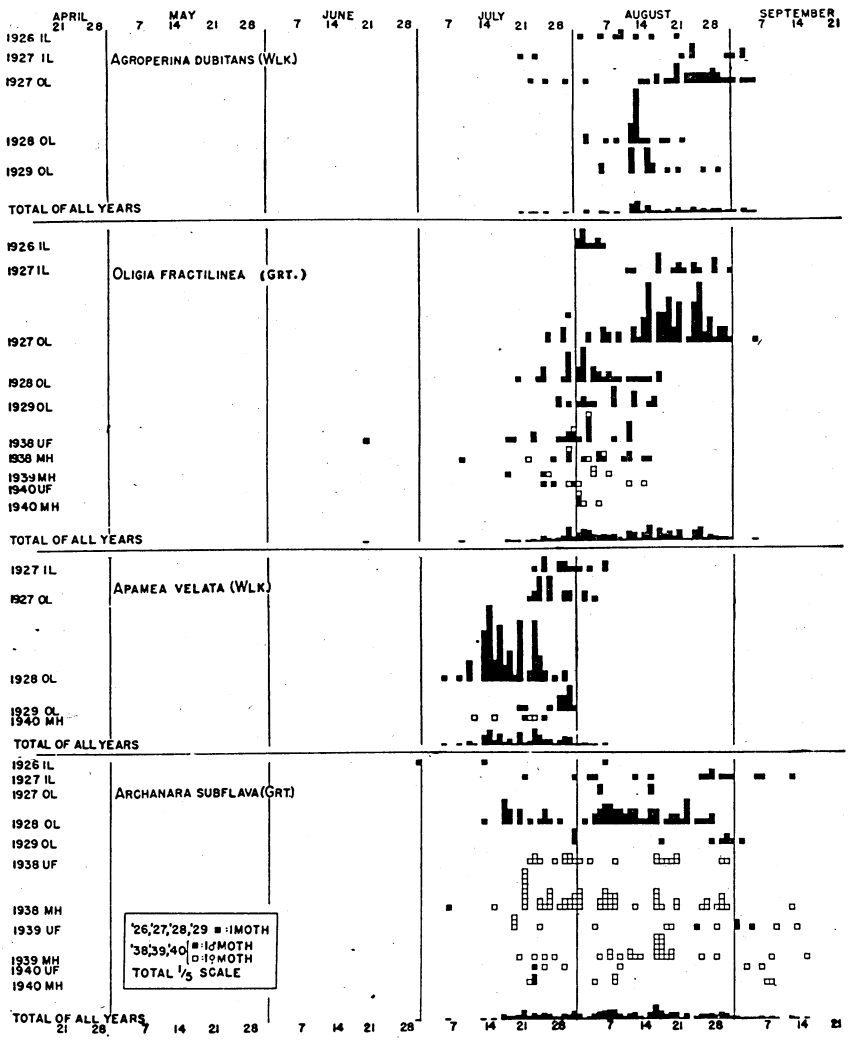
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
AGROPERINA DUBITANS (WLK.)
1927 OL
1928 OL
1929 OL
TOTAL OF ALL YEARS
1926 IL
1927 IL
OLIGIA FRACTILINEA (GRT.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1927 IL
1927 OL
APAMEA VELATA (WLK.)
1928 OL
1929 OL
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
1927 OL
ARCHANARA SUBFLAVA (GRT.)
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
'26,'27,'28,'29 ■ = 1 MOTH
'38,'39,'40 ■ = 1♂ MOTH
□ = 1♀ MOTH
TOTAL 1/5 SCALE

Plate XIV

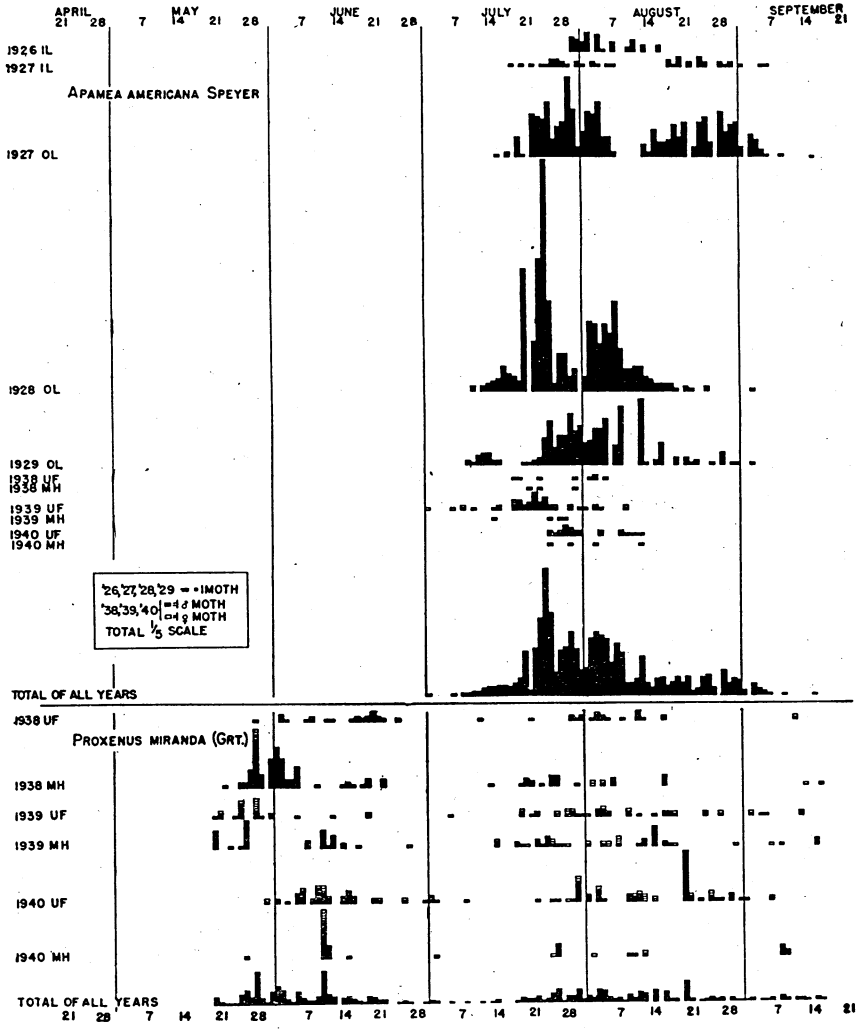
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
APAMEA AMERICANA SPEYER
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1 ♂ MOTH
= 1 ♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
1938 UF
PROXENUS MIRANDA (GRT.)
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XV

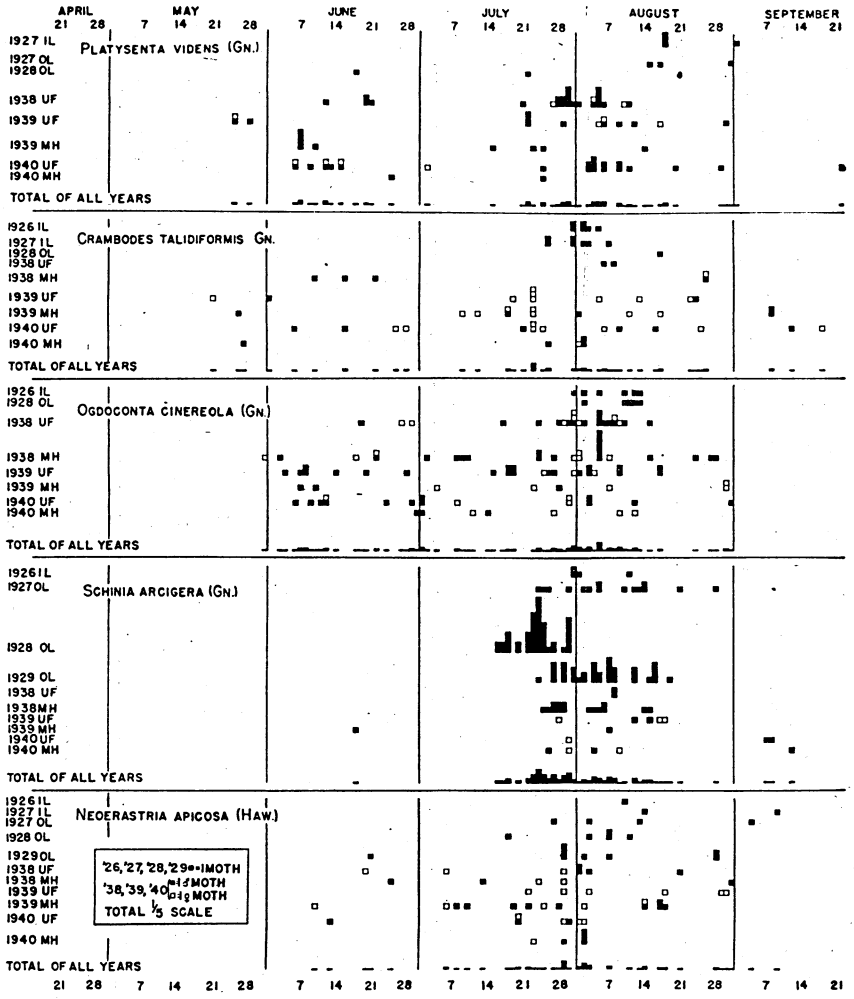
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
PLATYSENTA VIDENS (GN.)
1927 IL
1927 OL
1928 OL
1938 UF
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
CRAMBODES TALIDIFORMIS GN.
1926 IL
1927 IL
1928 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
OGDOCONTA CINEREOLA (GN.)
1926 IL
1928 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
SCHINIA ARCIGERA (GN.)
1926 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
NEOERASTRIA APICOSA (HAW.)
1926 IL
1927 IL
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
'26, '27, '28, '29 = 1 MOTH
'38, '39, '40 = 1 MOTH
TOTAL 1/3 SCALE
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XVI

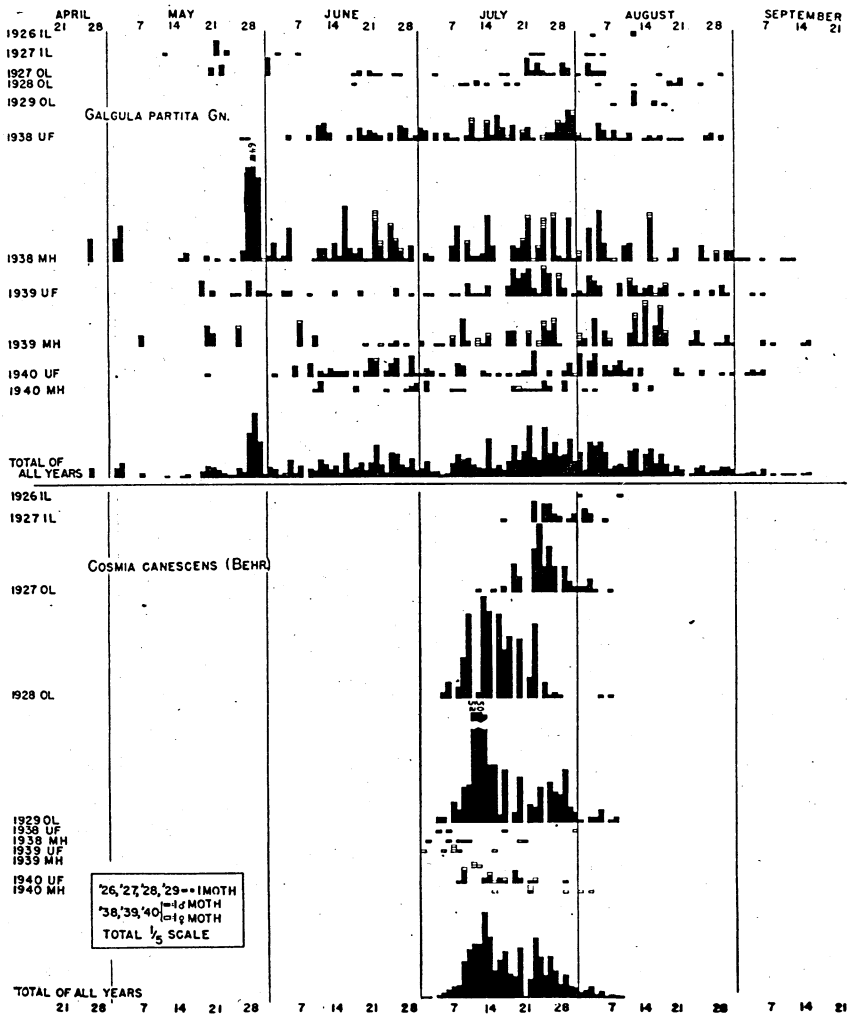
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
1927 OL
1928 OL
1929 OL
GALGULA PARTITA GN.
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
COSMIA CANESCENS (BEHR)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26, '27, '28, '29 = 1 MOTH
'38, '39, '40 = 1♂ MOTH = 1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XVII

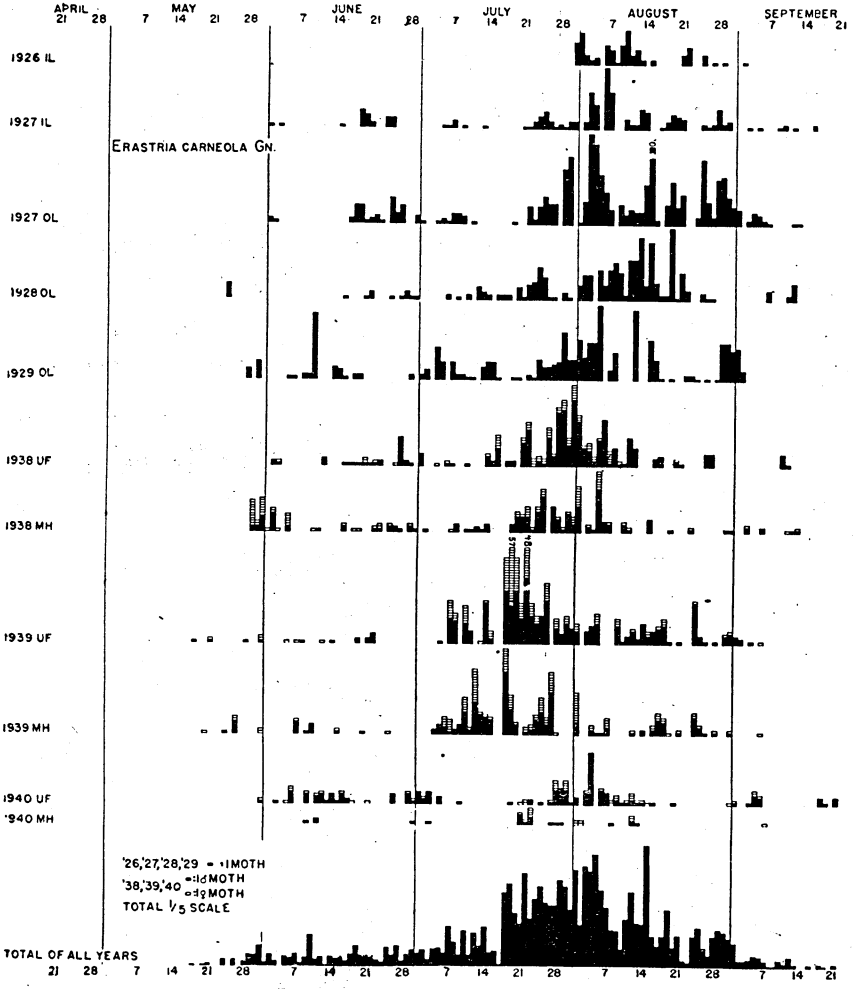
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
ERASTRIA CARNEOLA GN.
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = ♀MOTH
'38,'39,'40 = ♂♂MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XVIII

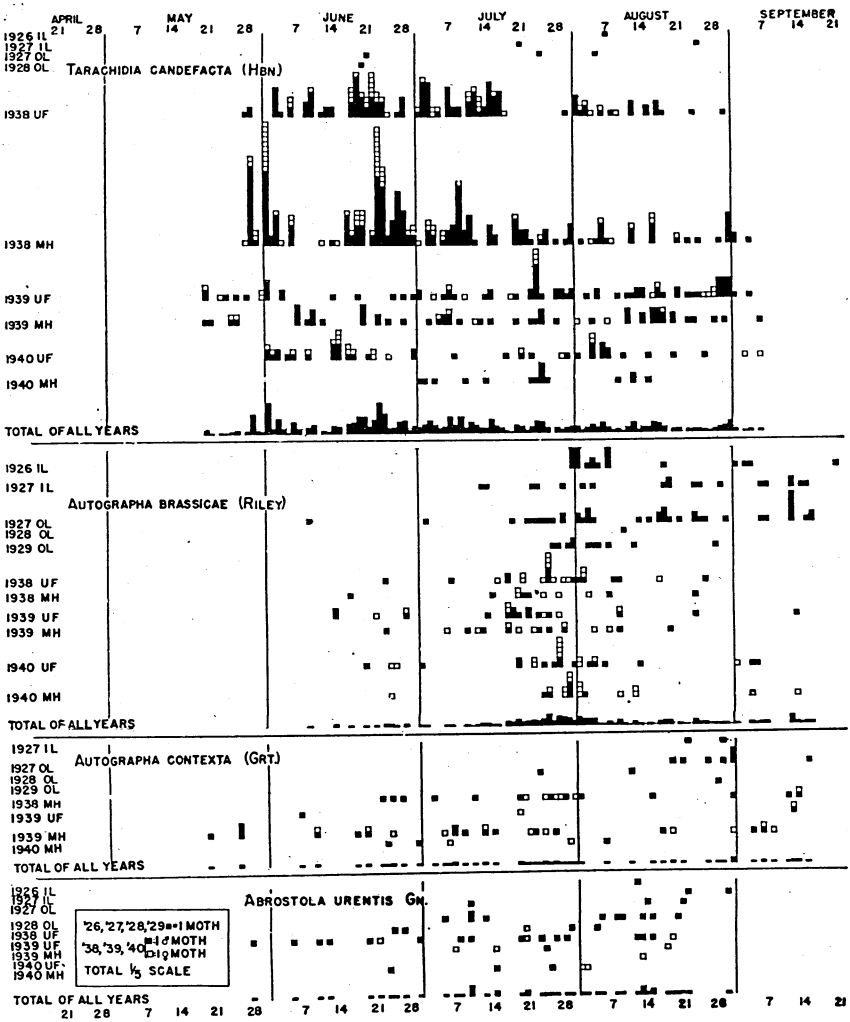
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
1927 OL
1928 OL
TARACHIDIA CANDEFACTA (HBN.)
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
AUTOGRAPHA BRASSICAE (RILEY)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
TOTAL OF ALL YEARS
1927 IL
AUTOGRAPHA CONTEXTA (GRT.)
1927 OL
1928 OL
1929 OL
1938 MH
1939 UF
1939 MH
1940 MH
TOTAL OF ALL YEARS
1926 IL
1927 IL
1927 OL
ABROSTOLA URENTIS GN.
1928 OL
1938 UF
1939 UF
1939 MH
1940 UF
1940 MH
'26, '27, '28, '29 = 1 MOTH
'38, '39, '40 = 1 ♂ MOTH
1 ♀ MOTH
TOTAL 1/3 SCALE
TOTAL OF ALL YEARS
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XIX

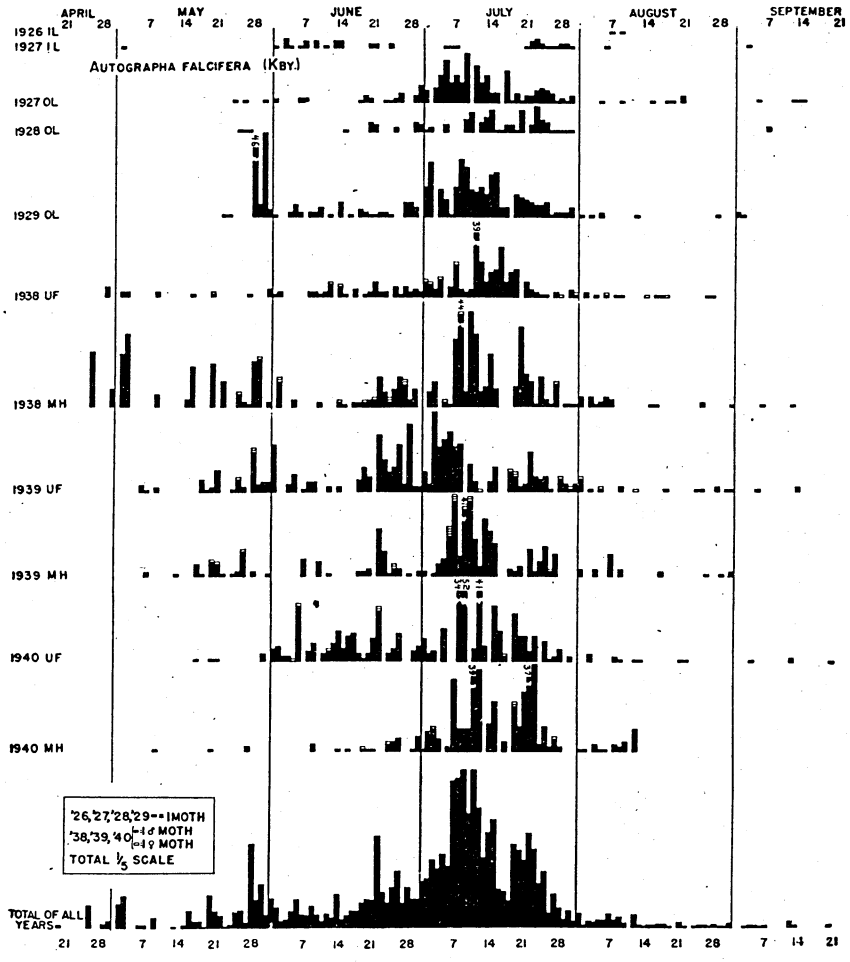
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21
1926 IL
1927 IL
AUTOGRAPHA FALCIFERA (KBY.)
1927 OL
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29--1 MOTH
'38,'39,'40 1 ♂ MOTH
1 ♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS-
21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21 28 7 14 21

Plate XX

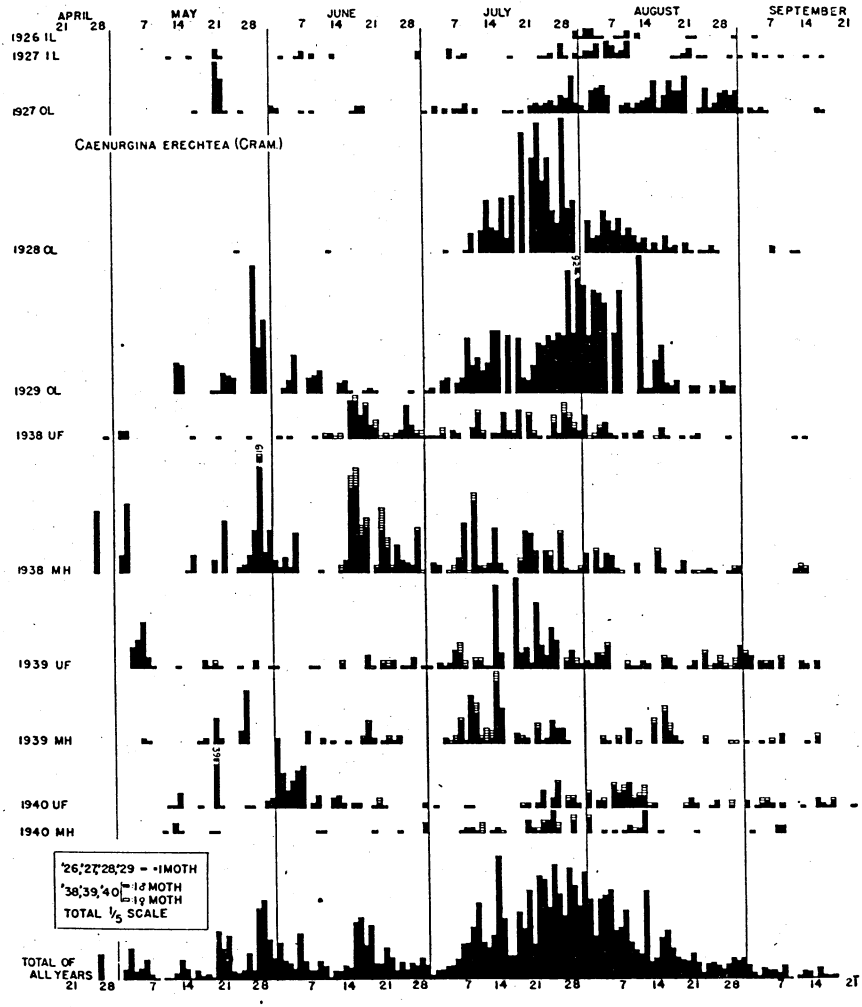
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1926 IL
1927 IL
1927 OL
CAENURGINA ERECHTEA (CRAM.)
1928 OL
1929 OL
1938 UF
1938 MH
1939 UF
1939 MH
1940 UF
1940 MH
'26,'27,'28,'29 = 1 MOTH
'38,'39,'40 = 1♂ MOTH
1♀ MOTH
TOTAL 1/5 SCALE
TOTAL OF ALL YEARS

Plate XXI

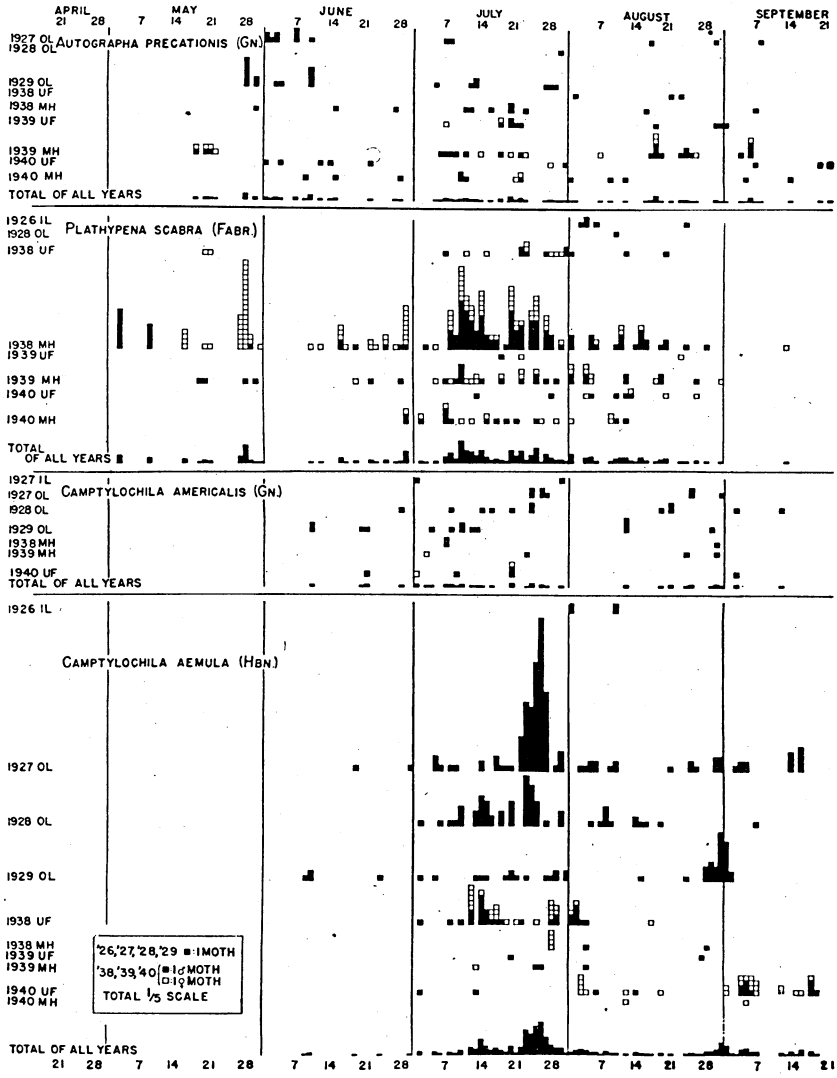
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
AUTOGRAPHA PRECATIONIS (GN.)
PLATHYPENA SCABRA (FABR.)
CAMPTYLOCHILA AMERICALIS (GN.)
CAMPTYLOCHILA AEMULA (HBN.)
TOTAL OF ALL YEARS
'26,'27,'28,'29 ■=1 MOTH
'38,'39,'40 ■=1♂ MOTH □=1♀ MOTH
TOTAL 1/5 SCALE

Plate XXII

HOST PLANT INDEX

INDEX OF SCIENTIFIC AND COMMON NAMES